DRAFT FINAL REPORT

MARKET STREET DESIGN PLANNING STUDY

Prepared for the
TRANSPORTATION POLICY GROUP
OF SAN FRANCISCO

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CHAPTER I
INTRODUCTION

Market Street has been and will probably remain a major element of the cityscape of San Francisco. Since the construction of the Bay Area Rapid Transit District (BART) right-of-way along Market Street, the Municipal Railroad (MUNI) has considered Market Street a major transit corridor.

In 1968, the citizens of San Francisco approved the funding of the Market Street Reconstruction and Beautification Project. Today portions of the street have been completed to the ultimate project designs as summarized below. The segment from the Embarcadero (M. Justin Herman Plaza) to Fremont Street is 100 percent complete including all granite curbs and gutters and all brick and granite crosswalks. The traveled way, including gutters, is 50 feet wide from curb to curb. No streetcar tracks presently exist in this area and all paving is new, completed to final design grades.

- From Fremont to Seventh Streets, all sidewalk areas are 100 percent complete. All curbs and gutters are temporary and incomplete (leaving Market Street 52 feet 6 inches wide from curb to curb) but all utilities and catch basins are completed in their final design location in anticipation of the planned 50 foot wide traveled way. All street elevations of BART station areas are at their final grade elevations and are newly paved. The streetcar track area must be repaved upon removal of track and the areas between BART stations must be regraded to new finished elevations and repaved. Any proposal for streetcars would require new track in these areas since the existing track is unsuitable for continued use.

- The Project is 100 percent complete from Seventh Street to Van Ness except for removal of streetcar tracks, repaving of track area and crosswalks. All

vehicle areas are at final grade elevations and recently paved. The curb-to-curb width from Seventh Street to Eighth Street is 50 feet. From Eighth Street to Twelfth Street it is 68 feet.

Significant emphasis needs to be placed upon the function of Market Street today as compared to 1968 when the Market Street Beautification Project was approved. The original project called for a minor transit configuration: namely, no trolley or streetcar service and a limited number of motor coaches. Today six of the seven busiest MUNI transit stops are located on Market Street between Powell and Battery. The seventh is on Mission Street at the Transbay Terminal. Many of the existing Market Street surface lines are the highest travelled lines in the MUNI system. In addition, four sets of transit tracks exist below grade for MUNI Metro and BART. While MUNI could probably shift their current transit emphasis to alternative routes such as Mission and Howard, it is questionable whether such a move would be practical. Moreover, the MUNI's current five-year plan reinforces the use of Market Street for transit.

The Market Street Design/Planning Study was initiated to develop an operations plan for Market Street between Steuart Street and Van Ness Avenue for two conditions: first, the best operating plan with streetcars on the surface; and second, the best non-streetcar plan.

Initially, consideration was given to operating historic streetcars on Market Street as far as Castro Street. Additionally, the feasibility of surface Metro operation from the tunnel portals near Castro along either Market or along 17th - Church - Market to the Transbay Terminal was explored. Both alternatives were evaluated and discarded early in the study process. This study was directed to limit analysis to no farther than Van Ness Avenue for an historic streetcar operation and to evaluate alternative ways of providing access to the Civic Center.[1]

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[1] Source: Glenn Erikson, Department of City Planning, coordinator of Study Transportation Policy Group.

The reasons for this early decision include the following:

- The design of Market Street west of McCoppin (Freeway) is set. The plan and outer Market was reached after protracted public hearings, community input, and a formal environmental impact report and does not envision streetcar operations.

- To extend tracks from Duboce to Castro would be expensive and require installation of additional loading islands that would conflict with the agreed upon plan for the streets.

- Streetcars cannot negotiate steep hills which the rail operation would encounter at Castro and Market. In contrast, the 8-Market trolley coach can negotiate steep hills and the MUNI 5-Year Plan calls for extension of the 8-line at least one block further south to 20th Street. Electrification of the 24-Divisadero, currently underway, would make it feasible to extend the 8-line to 24th Street in Noe Valley, if that became desirable. Streetcars cannot provide this kind of service.

- The existing tracks, west of McCoppin, including those on 17th Street and into the tunnel portals as well as the portal support structure are constructed with untreated wood and would have to be replaced before many years have passed.

- The operation of MUNI Metro on the surface of Market would require an entirely different and more costly overhead wire design. The pantograph pickup of the Metro cars requires complex and costly "special work" wherever it crosses or interacts with trolley coach overhead wire. The required four sets of trolley coach wires on Market between 8th and Fremont would be incompatible with a pantograph Metro overhead.

- Surface operation of Metro cars on Market Street would either preclude multi-car train operation or require very long loading islands. Conflicts

would ensue between Metro cars and the trolley coach and motor coaches assigned to the center lanes.

- Historic streetcars, operating in conjunction with the E-line along the Embarcadero, are envisioned as providing two primary functions. These are, 1. distribution of commuters from the Transbay Terminal, Ferry Terminal, and possibly a relocated Southern Pacific Terminal, in two directions -- north up the waterfront to and through the Wharf and west along Market to the Civic Center, and, 2. to provide an alternative to the cable cars as a distribution system for visitors to/from Ft. Mason, the Wharf, the Embarcadero, Ferry Building, Market Street, and the Civic Center. Both of these two primary functions decline dramatically beyond Van Ness Avenue.

Given these considerations, it was determined near the ouset of the Market Street Design/Planning Study to limit the streetcar alternatives from Van Ness to the east.

Similarly, it had been suggested that Moscone Convention Center be included in the route options. For similar reasons, this option was discarded early in the program as the north-south "detour" or "branch" required to serve Moscone simply did not fit in with the east-west configuration of a Market Street streetcar operation. The Transportation Element of the City Master Plan calls for alternative "shuttle" transportation to connect with Moscone Center, Yerba Buena Center, the peripheral parking lots south of Market Street.

Finally, at the east end, all alternatives were considered to be interconnected with the Embarcadero E-line and potentially operate as one system. A Market Street historic streetcar that only operated from Transbay Terminal to Van Ness Avenue would be too limited in service transportation fuction for the City. Several alternative routes for connecting to the E-line have been included in this study, but a "null" alternative that does not connect to the E-line was not considered viable on its own. In addition, streetcar access to possible maintenance and storage facilities was addressed.

The Problem

There are numerous deficiencies along Market Street today including inadequate loading islands, high levels of traffic congestion and temporary amenities (trolley and streetcar) along the length of the street. However, the numerous physical constraints existing along the street present the biggest problem associated with developing the plans suggested above.

Some constraints were created when MUNI Metro and BART were built. At that time, the use of the surface of Market Street for trolleys and streetcars (requiring islands) was not an element of the design. As a consequence, numerous constraints (BART vents, truck loading zone placement, track condition, BART entrance locations, right turn lanes and traffic conflicts) inhibit and in some cases specifically control any proposed operational plan.

The aim of the Market Street Design/Planning Study has been to develop a series of plans which meet the operational needs of Market Street while disrupting the area as little as possible. Since a major commitment in time and money already has been made to Market Street, it seemed inappropriate to arbitrarily redesign and rebuild the street in view of available less extreme alternatives. Therefore, the proposals included herein are viewed as feasible, cost-effective and practical.

Concurrent with this project, Tudor Engineers is conducting the Market Street Guideway Project: Rehabilitation of the Trolley Overhead Wire System. In order to facilitate coordination between the two projects to ensure compatibility, a two day workshop session was conducted at the outset of the Market Street Design/Planning Study. The intent was to resolve those issues concerning the surface of Market Street which had a bearing upon the overhead project and which were holding up the Tudor project due to the lack of resolution. The workshop was very successful; many broad concept alternatives for possible consideration in the Market Street Design/Planning Project were eliminated as impractical, too costly or infeasible.

Other Issues

The study assumes the existing mix of autos and transit on Market Street. Future transit demand was considered by evaluating the MUNI five-year plan for Market Street service. An auto-free Market Street alternative was not evaluated. Although auto-free operation would help transit, consideration of this alternative was not within the scope of this study. However, the operations plan has been developed in such a way that an auto-free configuration would enhance the aspects of the plan and minimize the need to change the elements of the plan should an auto-free option be adopted in the future.

CHAPTER II
EXECUTIVE SUMMARY

Market Street can accommodate either a surface transit operations plan that includes streetcars, in addition to trolley and diesel coaches, or a plan independent of streetcar operations.

The existing street includes narrow curb travel lanes, sections of non-useable trackage, and insufficient curb loading space to accommodate the Municipal Railway's five-year plan for Market Street. The recommended plans included in this report attempt to solve these deficiencies.

The basic parameters of the street for all plans between Steuart Street and Eighth Street are summarized below.

- Four transit/auto lanes — two inbound, two outbound.
- Loading islands, either 6 or 7 feet wide and 110 feet long. Islands were designed for low maintenance, including protective barrier and energy absorber.
- Allocation of trolley and diesel routes to both curb and island stops from Fremont to Seventh.
- Trolley and diesel bus operation in the curb travel lane west of Eighth Street. Streetcar service may or may not require islands on Market Street west of Seventh Street depending on route alternative selected.
- East of Fremont, trolleys and diesels would operate in the curb lane. Streetcars, if extended east on Market Street, would require islands.

- Two-lane parallel transit operation allows loading capacity for 200 standard coaches per hour on Market Street. With proposed MUNI service projections two-lane parallel operation would allow potential transit service growth up to 50 percent. However, due to intersection capacity constraints, this ideal capacity (200 buses per hour) cannot be achieved without substituting additional transit for auto traffic.

Three operations plan alternatives are presented: two with streetcar operations, one without streetcars. Under any operations plan option, the center transit/auto lanes must weave to accommodate a recommended curb-to-curb width of 51 feet. The 51 foot condition is required from Fremont to Seventh Street. Elsewhere, the existing 50 or 68 foot sections of Market Street will be retained. To accommodate the 50 foot condition, the loading islands would be narrowed by 1 foot.

These three alternatives are schematically depicted in Figure II-1 and summarized in Table II-1.

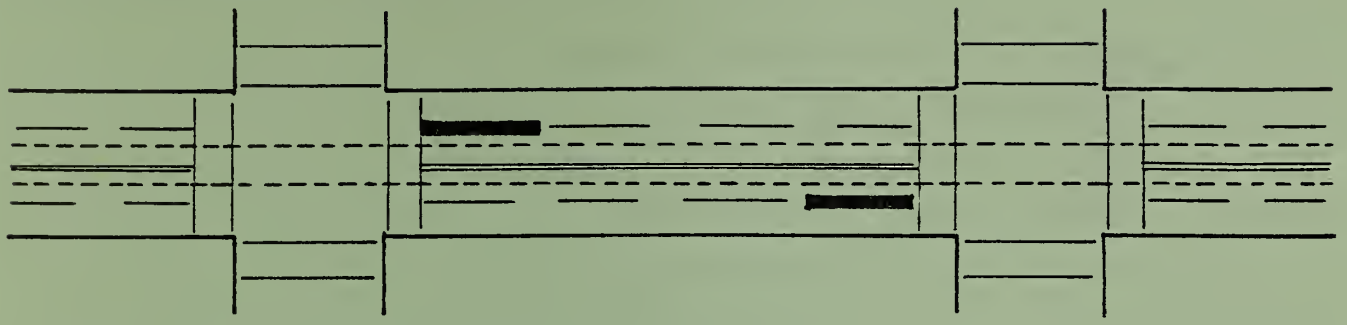
Alternative A (with streetcars)

Alternative A requires that all existing trackage be removed and replaced along Market Street from Fremont to Van Ness Avenue. In total, 17,800 lineal feet of new trackage is required. Standard curb lane widths (12 feet) and seven foot islands are provided. Curb encroachment is only necessary at one location near Second Street (approximately 200 lineal feet). This option requires weaving center transit/auto lanes and costs approximately $23,500,000 (Fremont Street to Van Ness Avenue).

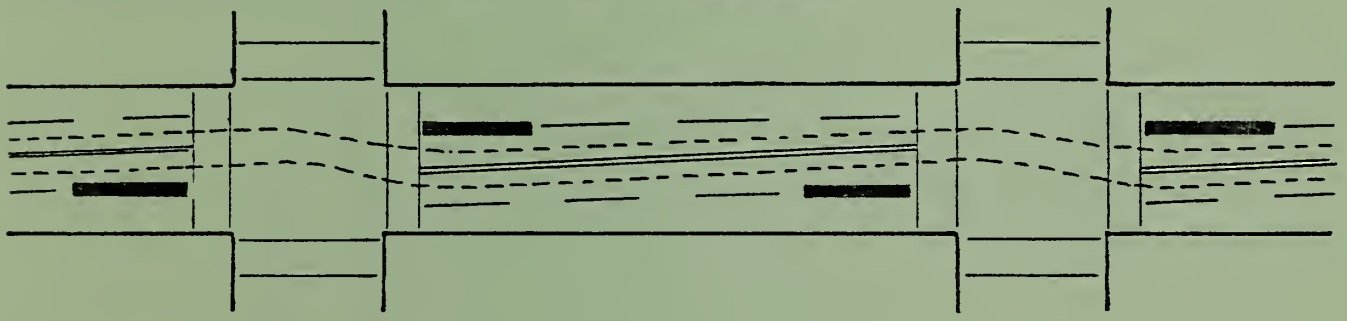
Alternative B (without streetcars)

This alternative requires the same street configuration as Alternative A (weaving lanes); however, streetcar tracks would be removed from Market Street. Curb modifications would be necessary at Second Street (approximately 200 lineal feet). This alternative costs $16,500,000.

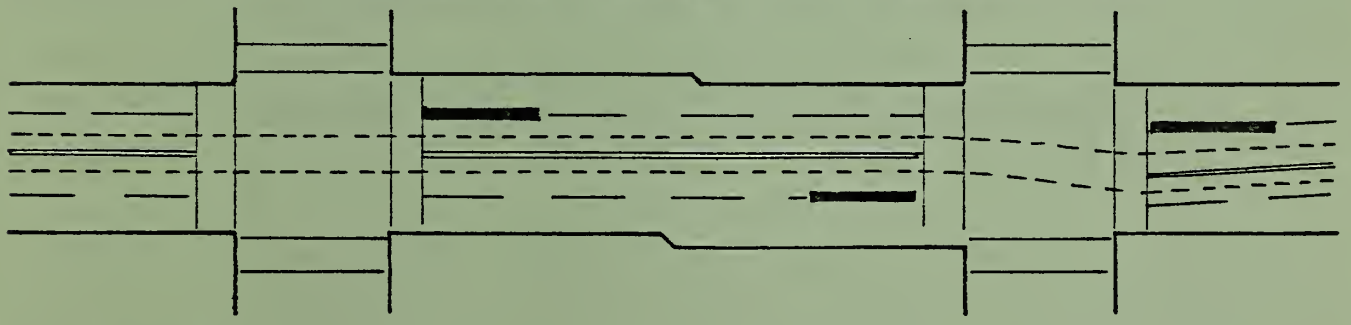
EXISTING STREET (Fremont to 7th)



ALTERNATIVE A (with streetcars -weave all tracks)
ALTERNATIVE B (without streetcars - weave lanes)



ALTERNATIVE C (with streetcars - keep good track/weave new track)



Islands
Streetcar tracks
Traffic lane markings

● **DKS Associates** ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE II-1 **MARKET STREET ALTERNATIVES**

Table II-1
SUMMARY OF ALTERNATIVES

	Passenger Islands[2]	Curb Bus Stops[3]	New Pavement (Square Feet)	New Track (Lineal Feet)	Curb Set Back (Lineal Feet)	Cost (1982 Dollars)
Original Project[1]	0	27[4]	360,000	0	0	$11,500,000
Alternative A	14	28	360,000	17,800	200	$23,500,000
Alternative B	14	28	360,000	17,800	200	$16,500,000
Alternative C	14	28	166,000	9,400	1,800	$18,100,000

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1 Market Street Reconstruction and Beautification Project.

2 Presently there are 23 passenger islands on Market Street. Alternatives A, B and C include no islands west of Seventh Street.

3 Currently there are 27 curbside bus stops on Market Street.

4 Assumed equal to number of bus shelters provided.

Alternative C (with streetcars)

This second streetcar plan allows retention of those portions of the trackage on Market Street that are in good condition and do not require replacement. Alternative C requires that only 9,400 feet of new trackage is required, a decrease over Alternative A of 47 percent; however, adjacent to the loading islands where good trackage is maintained approximately 1,800 lineal feet of curb would need widening to accommodate an eleven foot curb lane and seven foot island configuration. The 11 foot curb lane is a substandard width for situations between island and curb. This alternative costs $18,100,000.

Original Project

The completion of the original Market Street Reconstruction and Beautification Program from Fremont Street to Van Ness Avenue is estimated to cost $11,500,000 (1982 dollars). This work would include removal of all streetcar tracks and passenger islands with pavement reconstruction and new granite curbs and gutters between Fremont and Seventh Streets.

With future streetcar operation, the existing track configuration provides a loop turnaround at the Transbay Terminal and a switch back at the Eleventh Street wye. Proposed MUNI plans envision future "historic" streetcar service on Market Street which tie into the Embarcadero creating the new F-line to Fort Mason. This study evaluated several possible track connection alternatives from Market Street to the Embarcadero. The most promising track connections appear to be via Drumm/Washington Streets or via Howard Street serving the Transbay Terminal.

Streetcar service would have a western terminus on Market Street between Van Ness Avenue and Eighth Street. To expand patronage potential, route alternatives were developed which attempt to better serve the government/cultural complex at Civic Center. A Larkin/McAllister/Van Ness/Market loop or a United Nations Plaza stub end would seem to be the most practical alternatives.

A rough patronage estimate was developed assuming streetcar service from Civic Center to Fisherman's Wharf/Fort Mason. Approximately 780 to 1,440 passengers per hour could be expected to utilize future streetcar service.

It is anticipated that the proposed streetcar line would serve four primary users:

- local trips along Market Street;
- employment and recreational facilities along the northeast waterfront;
- tourist/visitors; and
- to relieve overcrowding on the popular Powell Street cable car lines.

CHAPTER III
EXISTING CONDITIONS

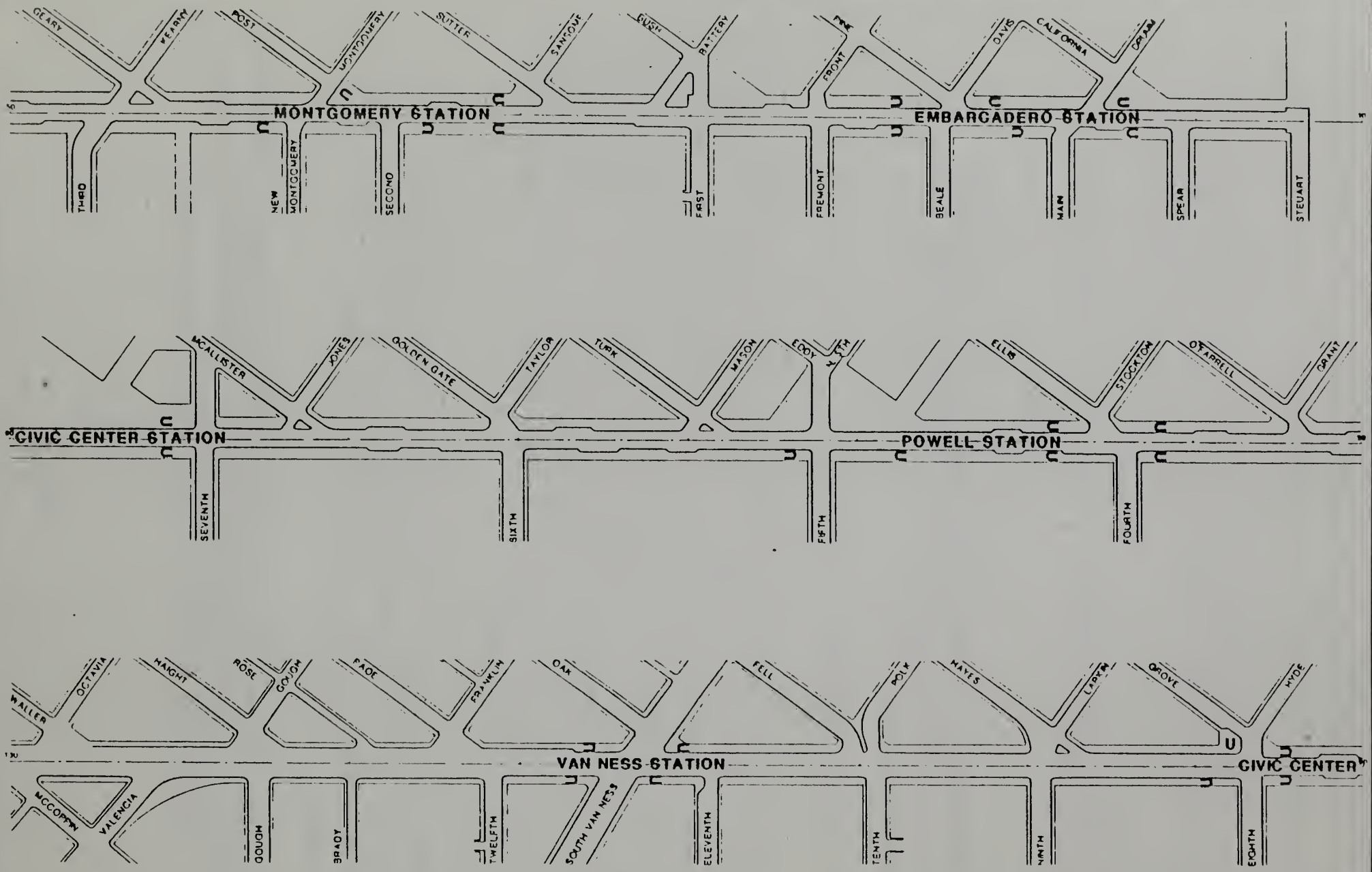
This chapter reviews the existing Market Street roadway characteristics, traffic conditions, truck activity, transit operation and pedestrian movements. Each of the preceding topics are discussed below.

ROADWAY CHARACTERISTICS

Market Street presently has four travel lanes (two in each direction) between Steuart Street and Van Ness Avenue with right turn lanes at some intersections. The curb-to-curb dimension along Market Street between Steuart and Eighth Street varies depending on the use of temporary (3-3/4") concrete or permanent (18-3/4") granite curb. From Steuart to Fremont Streets and from Seventh to Eighth Streets, Market Street has a 50 foot cross-section. Temporary curbs are utilized between Fremont and Seventh Streets where Market Street is 52-1/2 feet curb-to-curb. Market Street widens to a 68 foot cross-section west of Eighth Street. Throughout this report, any reference to widening is based upon this existing cross section.

No on-street parking is allowed on Market Street. Specially designated truck loading zones are provided at 16 locations along Market Street between Fremont Street and Eighth Street. To accommodate truck parking in loading zones, the curb line has been set back approximately nine feet.

All BART/MUNI Metro access escalators (see Figure III-1), street lighting, traffic signals and overhead wire poles are located on the sidewalk. Other than the streetcar tracks and islands, the Market Street cross-section is free of traffic or transit equipment.



⊂ Passenger entrance point

● DKS Associates ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE III-1 **BART/MUNI METRO STATION ENTRANCES**

The condition of pavement on Market Street is generally satisfactory (see Technical Appendix for details of pavement condition). However, excessive pavement cross slopes exist at Ninth Street, between Seventh and Turk/Mason, between Grant/O'Farrell and Annie Plaza and near First Street. Some localized pavement repair is necessary, primarily adjacent to the existing streetcar tracks between Fremont and Sutter Streets and from Van Ness Avenue to Eighth Street.

TRAFFIC CONDITIONS

Market Street is identified as a major thoroughfare within the City Comprehensive Plan.[1] However, due to turning movement restrictions, heavy transit integration and lack of signal progression, Market Street basically serves as a circulation route in the financial district. Average daily traffic (ADT)[2] along Market Street ranges between 10,000 and 18,000 vehicles per day.

In consultation with the Transportation Planning Group Project Coordinator, ten intersections were selected for analysis on Market Street (Figure III-2). Manual turn counts were conducted at the ten study intersections during the morning, midday and evening peak periods (see Technical Appendix for complete count summaries). Traffic volumes on Market Street between Fifth Street and Van Ness Avenue were heaviest during the evening peak while in the financial district (below Third Street) traffic volumes tended to be slightly greater in the morning peak.

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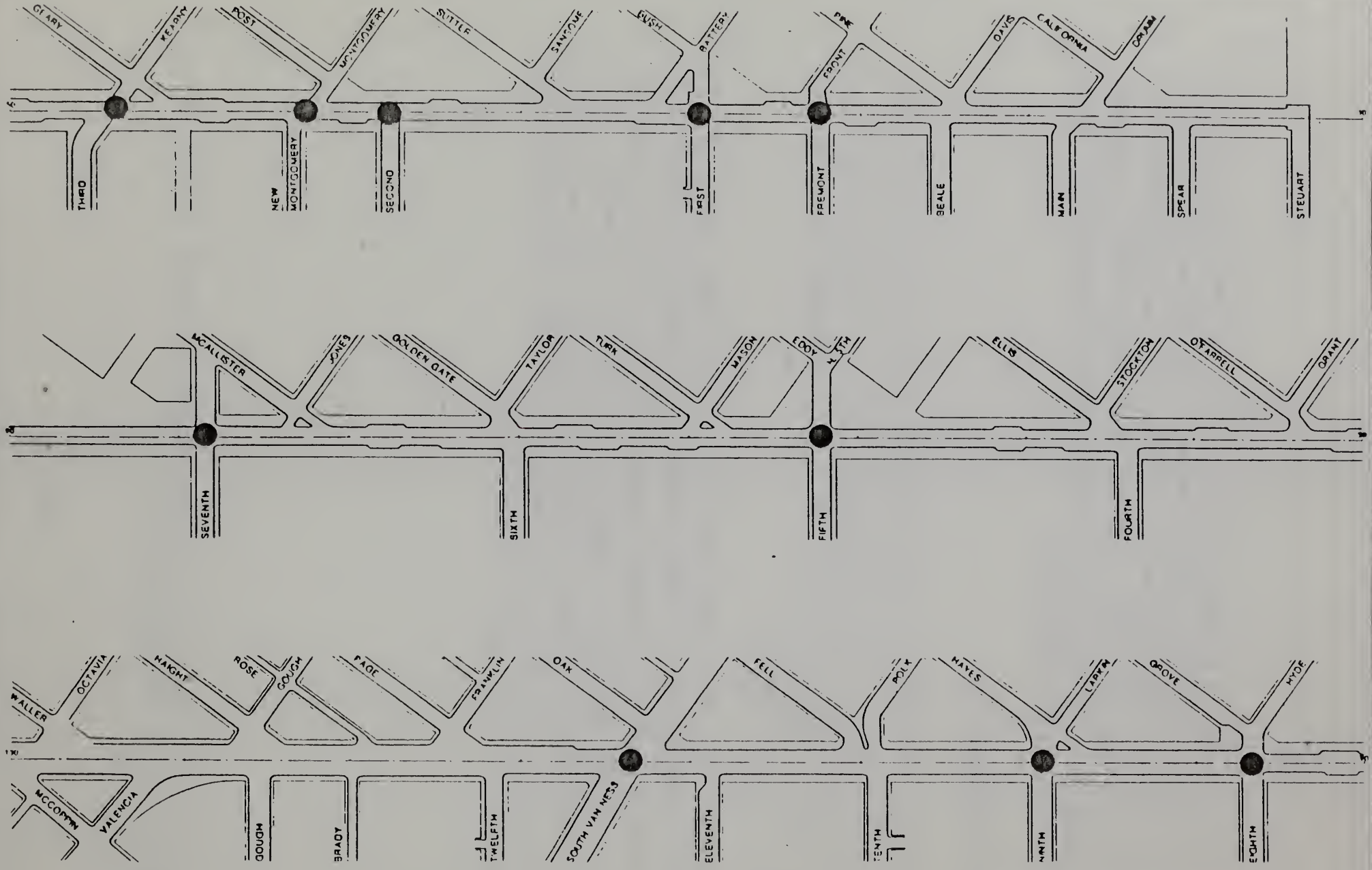
1 City and County of San Francisco, "The Comprehensive Plan: Transportation", adopted 27 April 1972, Resolution 6824.

2 Two-way ADT.



● **DKS Associates** ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE III - 2 **INTERSECTION TURN COUNTS**

Generally, traffic volumes on Market Street have increased compared to previous data collected in 1980[1] and 1981.[2] The increase probably reflects the elimination of weekday street car service (August 1981) and the ability of vehicles to more freely use the center-track lanes.

Signal System

There are 21 signalized intersections on Market Street between Drumm/Main Street and Van Ness Avenue. The majority of signals on the east end of Market use single-setting 60 second cycle lengths. On the west end of Market, near Van Ness Avenue, 70 and 75 second cycle lengths are used during peak hour conditions (Table III-1).

Interconnection cable for two signal systems exists on Market Street between Steuart Street and Van Ness Avenue. The lower Market·Street system interconnects all signals between First Street and Eighth Street. The signals between Ninth Street and Van Ness Avenue have interconnect cable which is part of the outer Market Street signal system which continues to Noe Street. No interconnect cable is present on Market Street from Steuart Street to First Street and between Eighth and Ninth Streets. Generally, signal coordination and progression are not presently provided along Market Street. The signal offsets are not set for traffic progression and were basically last modified to improve streetcar flow.

Intersection Capacity

Levels of service and volume-to-capcity ratios were determined for both morning and evening peak periods at the ten study intersections. Intersection performance was analyzed based on critical movement analysis (see Technical Appendix) which accounted

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1 San Francisco City Planning Commission, "Hotel Ramada San Francisco Environmental Impact Report", EE 80-171, Certified January, 1981.

2 DKS Associates, "Transportation Impact Analysis for 171 New Montgomery Street", November, 1981.

Table III-1
EXISTING MARKET STREET SIGNAL SYSTEM

Intersection	AM Peak Cycle Length	AM Peak Split	PM Peak Cycle Length	PM Peak Split
Main/Drumm	60	38/62	60	38/62
Beale/Davis	60	50/50	60	50/50
Fremont/Front	60	50/50	60	50/50
First/Battery	60	38/17/45	60	38/17/45
Sansome/Sutter	60	58/42	60	58/42
Second	60	67/33	60	67/33
New Montgomery	60	45/55	60	45/55
Third/Kearny	60	50/50	60	50/50
Grant/O'Farrell	60	67/33	60	67/33
Fourth/Stockton	60	50/50	60	50/50
Powell	60	60/40	60	60/40
Fifth	60	50/50	60	50/50
Mason/Turk	60	48/52	70	48/52
Sixth	70	53/47	70	53/47
Jones/McAllister	70	50/50	70	50/50
Seventh	70	40/60	70	40/60
UN Plaza	70	69/31	70	69/31
Eighth	70	48/52	70	46/54
Ninth	70	58/42	75	39/61
Tenth	70	60/40	75	48/52
Van Ness	70	50/50	75	34/66

NOTE: Split refers to the percentage of green time (including amber) presented as Market Street/cross street.

for bus, truck and pedestrian activity along Market Street. The impact of bus operation on intersection performance was developed assuming buses were equivalent to varying numbers of passenger cars according to stop characteristics. Passenger car equivalents (PCEs) were also developed for truck (one truck equals two PCEs) and pedestrian activity.[1] Table III-2 presents the level of service and volume-to-capacity ratios for the study intersections during morning and evening peak hour conditions.

Table III-2
INTERSECTION PERFORMANCE
Market Street 1982

Intersection	AM Peak	PM Peak
Fremont/Front	E (0.92)	D (0.82)
First/Battery	C (0.74)	C (0.74)
Second Street	B (0.66)	B (0.60)
New Montgomery	D (0.87)	E (0.94)
Third/Kearny	C (0.70)	C (0.75)
Fifth Street	C (0.76)	D (0.88)
Seventh Street	B (0.64)	D (0.82)
Eighth Street	C (0.76)	D (0.85)
Ninth Street	C (0.76)	D (0.86)
Van Ness Avenue	D (0.81)	C (0.73)

NOTE: Letter represents level of service and number in parenthesis represents volume-to-capacity ratio.

Market Street levels of service are typically in the "C" to "D" range, representing restricted vehicle operation with minor congestion. The greatest traffic delays are near the financial district where concentrations of vehicular and pedestrian activity are highest. For example, Market Street at New Montgomery Street operates at level of service "E" during the evening peak. Long vehicle queues extend along the curb lane of eastbound Market Street, sometimes from Montgomery Street to Third Street.

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1 Based upon "Interim Materials on Highway Capacity", Transportation Research Board, Circular Number 212, Washington, D.C., January, 1980 (see Technical Appendix for details).

Many intersections along Market Street experience congested operation for small periods within the peak hour; however, over the entire peak hour, average traffic conditions tend to only approach unstable flow. For example, at Third Street vehicles will occasionally queue beyond Jessie Street causing them to wait for an additional red light. However, the majority of traffic is able to cross Market Street without waiting through additional signal cycles. Intersection performance generally improves west of Fifth Street where bus volumes and pedestrian activity are lower.

TRUCK ACTIVITY

Percent Trucks

Truck counts were performed at each study intersection during peak traffic conditions in the morning and evening. Trucks were defined as delivery vans or any vehicle with six or more tires touching the pavement. The percentage of trucks on Market Street are summarized in Table III-3. During peak morning and evening traffic conditions, trucks represent between one and six percent of all vehicle traffic on Market Street. Truck activity is much greater during the morning peak than the evening peak.

Table III-3
MARKET STREET VEHICLE CLASSIFICATION
Percent Buses and Trucks

	AM Peak		PM Peak	
Location	Buses	Trucks	Buses	Trucks
Fremont	12	4	9	3
First	16	3	13	1
Second	18	6	17	2
Montgomery	17	2	14	1
Third	17	6	12	1
Fifth	17	5	13	1
Seventh	14	4	13	1
Eighth	11	4	6	1
Ninth	12	3	8	1
Van Ness	7	4	6	1

Source: DKS Associates, Field Counts, March and June 1982.

Loading Zones

There are 16 truck loading zones along Market Street between Fremont and Eighth Streets (eight along the northern and eight along the southern curb). The specifically designed curb setbacks provide room for approximately 52 trucks to park along Market Street. These zones are actively utilized by trucks making deliveries along Market Street. Table III-4 summarizes the loading zone characteristics and occupancy rates during the evening peak period.

Loading zones between Third and Sixth Streets are well utilized. However, use of loading zones by passenger cars was most frequent between Third and Fourth Streets. Where pasenger cars illegally utilize loading zones, trucks are occasionally forced to double park adjacent to designated zones to load and unload. This results in blockage of the curb travel lane and presents an impediment to transit and traffic flow (see Technical Appendix for further discussion). Loading zones adjacent to fast-food restaurants appear to be frequently violated by passenger vehicles.

TRANSIT OPERATIONS

Current Service Levels

Market Street is one of the highest transit use streets in the City. It has been designated in the City's Master Plan as a transit preferential street. The MUNI Five Year Plan[1] assigns high priority for immediate action to enhance Market Street transit operations.

Sixteen (16) transit routes operate along Market between Steuart Street and Van Ness Avenue. Of these, seven routes use electric trolley coaches and nine use diesel motor coaches. The maximum frequency occurs during morning and evening peak hours when individual bus headways vary between 4 and 10 minutes. All routes have eastern termini

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1 San Francisco Municipal Railway, "Five-Year Plan: 1980-1985", April 1980, pg. 175.

Table III-4
LOADING ZONE UTILIZATION

Location	Length (Feet)	Spaces (Trucks)	Occupancy (Vehicles/ Zone/hour)	Percent Trucks Utilizing Zone*	Average Duration (Minutes)
North Curb					
Front/Bush	75	3	1.7	100%	84
Sutter/Post	80	3	6.3	36%	19
Post/Geary**	150	6	7.4	62%	19
Geary/O'Farrell	75	3	5.7	50%	33
O'Farrell/Ellis	80	3	9.1	33%	14
Ellis/Fifth	80	3	6.3	64%	22
Turk/Golden Gate	100	4	6.3	73%	15
Golden Gate/McAllister	110	4	7.4	54%	16
UN Plaza	75	3	1.1	100%	103
South Curb					
First**	120	4	6.3	27%	16
Second/New Montgomery	65	2	6.9	50%	28
New Montgomery/Third	90	3	5.7	90%	43
Third/Fourth	170	6	16.0	36%	18
Fourth/Fifth	80	3	10.3	56%	12
Fifth/Turk	65	2	4.0	71%	28
Turk/Sixth	100	4	6.9	83%	35
Sixth**	105	4	0.6	0%	5
Sixth/Seventh	80	3	6.9	33%	18
UN Plaza	75	3	6.9	50%	15

* Number of trucks divided by total number of vehicles (including autos) using loading zone.

** Curb set back for right turn lane, commonly used illegally by loading vehicles.

at either the Transbay Transit Terminal south of Market or near the Ferry Building adjacent to Steuart Street. For each route serving Market Street, Table III-5 shows frequency in terms of buses per hour and the type of vehicles each route employs.

All routes, with the exception of the 38 line, are scheduled to stop along the curb throughout the length of Market Street. Figure III-3 shows the designated curb stop locations which exist today. Route 38 buses generally operate down the center of Market Street and use the existing streetcar islands to load and unload passengers.

Currently, 59 buses per hour are scheduled to depart from the Ferry Building during peak conditions and 56 buses per hour from the Transbay Terminal. The maximum number of buses (122) operating on Market Street should occur between Fremont and Sutter Streets. Along this segment of Market Street, 85 buses have curb stops and 30 buses have island stops.

Surveys of existing transit volumes[1] indicate that on-street, peak hour bus service is 23 to 33 percent less than scheduled. At Montgomery Street, 115 buses should pass by during the evening peak hour in each direction. Only 88 westbound and 77 eastbound coaches were observed. This is primarily due to vehicle shortages currently being experienced by MUNI.

Current Route Structure

Currently, all transit service along Market Street with the exception of the Route 38 buses operates along the curb. Field observations of bus operations along Market Street indicate that uniform headways are not maintained between buses. The existing service levels would indicate an average peak hour headway of approximately 28 seconds (3,600 seconds/131 buses). In actual operation, buses tend to run in groups of three. Due to the lack of available curb space, the trailing third bus is unable to immediately unload

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1 Conducted by DKS Associates, Market Street at Montgomery Street, June 11, 1982.

Table III-5
MARKET STREET TRANSIT OPERATIONS
Existing and Proposed Service Levels

Route Number	Terminus	Type of Coach	WESTBOUND PM PEAK HOUR SERVICE Current[1]	Proposed[2]	Net Change
2	Ferry Building	Diesel	7	7	-
3	"	Trolley	-	9	+9
7	"	Trolley	7	12	+5
8	"	Trolley	12	15	+3
21	"	Trolley	10	15	+5
25	"	Diesel[3]	-	12	+12
31	"	Diesel	9	8	-1
71	"	Diesel	4	7	+3
Subtotal (Ferry Building)			(49)	(85)	
4	Transbay Terminal	Trolley	-	8	+8
5		Trolley	15	15	-
6	"	Trolley	6	12	+6
38	"	Diesel[3]	26	22	-4
Subtotal (Transbay Terminal)			(47)	(57)	
TOTAL			96	142[4]	+46

1 Actual service currently being provided, measured at Market and Sutter. (June and July 1982).

2 Scenario XV (1991) Summary Fleet Requirement, prepared by MUNI Staff. (Sue Stropes) as basis for San Francisco Municipal Railway Fleet Rehabilitation and Replacement Plan, July 1, 1982.

3 Routes which presently utilize diesel coaches which will be converted to trolley coaches under Scenario XV.

4 This increase in vehicle demand is a "minimum" increase because Scenario XV assumes the maximum use of articulated coaches. If fewer articulated coaches are placed in service, the total number coaches would be greater than 141/hour.

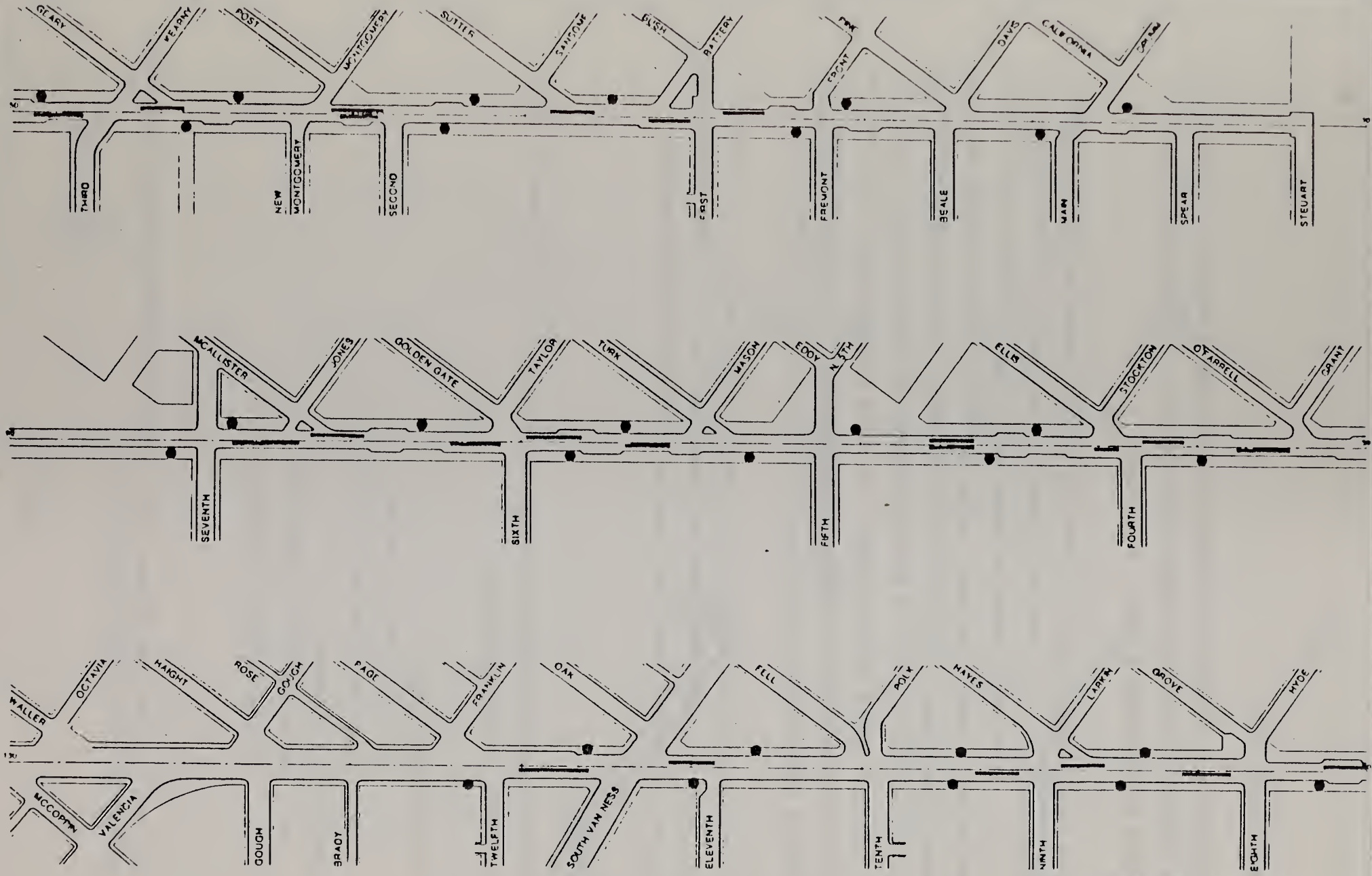

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FIGURE III - 3

EXISTING STOP LOCATIONS

and board passengers. Delays are not large since the average loading and unloading times for most vehicles are very short except at peak locations. This characteristic results in fast turnover at most curbside stops.

During the peak operating conditions, many curbside bus routes will utilize the center travel lanes to avoid traffic backups. Generally, where heavy right turn movements occur or where large signal delays are experienced, diesel and trolley coach drivers maneuver around congested locations. Large eastbound queues on Market Street at Montgomery Street cause most (90 percent) of the transit vehicles to use the center lane to bypass back-ups and delays. At First and Market, 56 buses turn right to reach the Transbay terminal during peak operations. To avoid traffic queues, transit vehicles utilize the existing streetcar signal for right turns onto First Street from the center lane (see Technical Appendix for further discussion of Market Street transit operation).

Seven routes cross Market Street in the study area (Figure III-4). The amount of transfers between Market Street routes and cross street lines is currently under study.[1] SamTrans and Golden Gate Transit also cross Market Street which allows transfers.

Boarding Study

Boarding and alighting studies were conducted at seven locations throughout the length of Market Street. These locations were:

- Inbound AM peak period
    - Third and Market - Curb stop
    - Emporium on Market - Curb stop
- Outbound PM Peak period
    - Sutter and Market - Island stop
    - Sutter and Market - Curb stop

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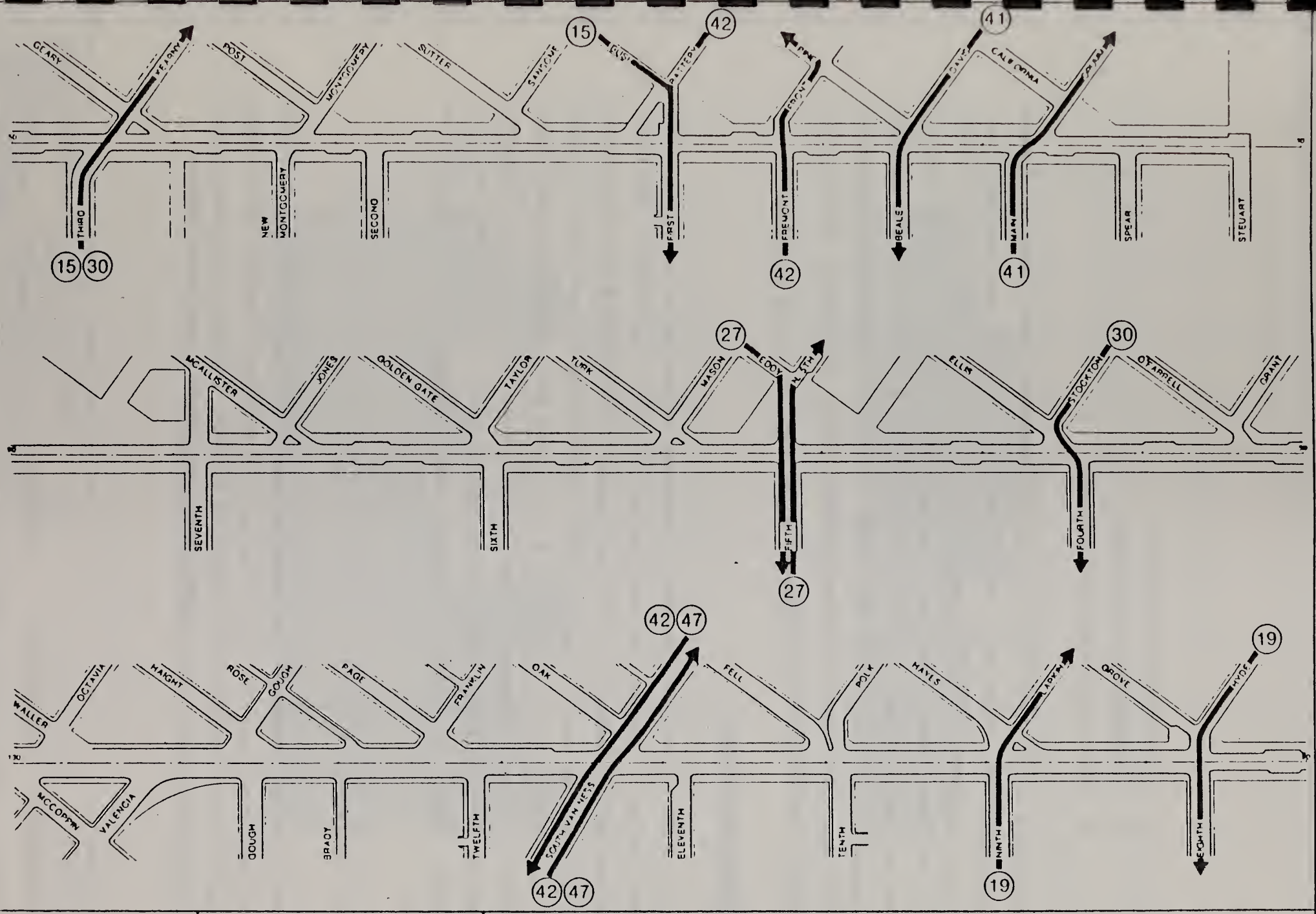
1 San Francisco Municipal Railway, "Muni Schedule Adherence and Data Collection and Analysis", commenced February 1982.



● **DKS Associates** ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE III - 4 **MUNI ROUTES CROSSING MARKET STREET**

- Hallidie Plaza - Curb stop
- 7th and Market - Curb stop
- Van Ness and Market - Curb stop

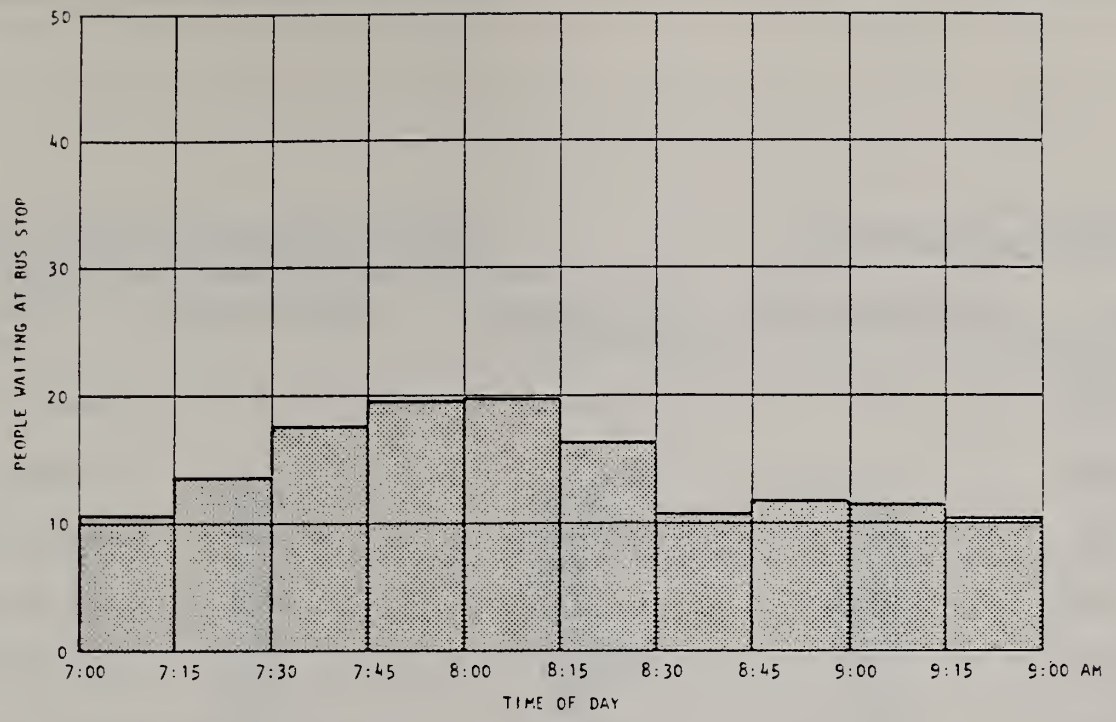
The boarding and alighting data were used to project the future levels of passenger accumulations which might occur along Market Street if routes were assigned to both curb and island stops. Figure III-5 summarizes the stop accumulation data at Hallidie Plaza and Third Street. The level of passenger accumulation varied from 20 at the Sutter and Market island to 50 at the Hallidie Plaza curbside stop. The maximum passenger accumulation levels were used to design the island size required to accommodate center line transit boarding and alighting. Island design parameters are discussed in detail later in the report.

Proposed Service Levels

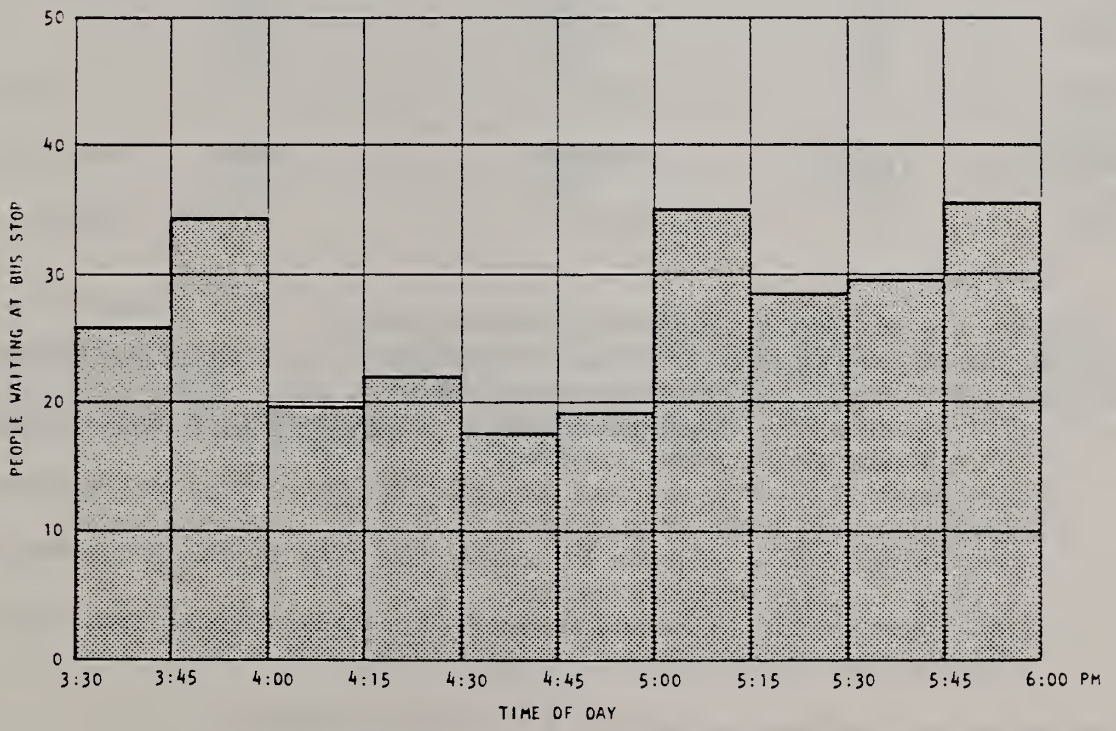
MUNI, as part of its Five Year Plan, is expanding various routes serving the Market Street corridor. Generally, all existing service will be maintained in the future. Proposed service changes call for a net increase of 51 scheduled bus movements on Market Street between Fremont and Sutter Streets during the peak hour. The major service changes include routing the 3, 4 and 25 lines onto Market Street and making significant service improvements to the 5, 6 and 71 lines. Table III-5 shows the projected levels of expanded transit service along Market Street for 1991 under a no-growth scenario. Table III-6 presents four different service proposals for the years 1991 and 2001.

PEDESTRIAN MOVEMENTS

Market Street is a densely utilized pedestrian corridor which serves as an axis for transit, retail and business activity. During the noon hour pedestrian volumes on Market Street sidewalks vary from 900 to 4,300 pedestrians per hour. The most concentrated activity occurs near Montgomery and Powell Streets (Table III-7).



Third Street Stop - Morning Peak, Eastbound



Hallidie Plaza Stop - Evening Peak, Westbound

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Table 6
PROPOSED BUS SERVICE[1]*

Route	1991 Scenario IV	1991 Scenario IX	2001 Scenario V	2001 Scenario XIII
Streetcar:				
F	0	8	8	8
Trolley:				
3	8/0[2]	9/0[2]	8/0[2]	10/0[2]
4	7/0	8/0	7/0	9/0
5	15/0	15/0	0/10	0/12
6	10/0	12/0	10/0	0/9
7	10/0	12/0	0/7	0/9
8	12/0	12/0	0/8	0/10
21	12/0	12/0	12/0	0/10
25	10/0	0/8	0/7	0/9
38	12/6	0/17	0/15	0/19
Diesel:				
2	7/0	8/0	7/0	9/0
16X	(12/0)	(13/0)	(0/8)	(0/10)
31	0/7	0/8	0/7[3]	0/8[3]
71	9/0	10/0	0/6[3]	0/8[3]
SUMMARY:				
Standard/Artic.	112/13	98/33	44/60	28/94
TOTAL	125	139	112	130

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1 Scenarios developed by MUNI Planning staff as part of:
MUNI, ABAG, MTC, and SFDCP, "Methodology for Projecting Future MUNI Demand and Vehicle Requirements", June 1982.

- 1991 Scenario IV -- No demand growth, maximize trolley coach deployment, minimize use of articulated coaches.
- 2001 Scenario V -- No demand growth, maximize trolley coach deployment, maximize use of articulated coaches.
- 1991 Scenario IX -- Demand increases, maximize trolley coach deployment, minimize use of articulated coaches.
- 2001 Scenario XIII -- Demand increases, maximize trolley coach deployment, maximize use of articulated coaches.

2 Number of standard coaches/number of articulated coaches.

3 Lines 31 and 71 converted to trolley coach operation by year 2001.

( ) Numbers in parenthesis indicate the 16X does not operate through most heavily used segment of Market Street (Fremont to Sutter).

Table III-7
MARKET STREET SIDEWALK VOLUMES
Noon Hour Sample Counts (Two-way Volumes)[1]

Location	North Sidewalk	South Sidewalk
Steuart to Main	2700	2000
Main to Beale	1700	1800
Beale to Fremont	1700	1800
Fremont to First	----	3400
First to Second	2000	3200
Second to Montgomery	4300	3100
Montgomery to Third	3200	2500
Third to Fourth	2500	2100
Powell	2700	3900
Fifth to Sixth	1500	2200
Sixth to Seventh	1100	2100
Seventh to Eighth	1000	1000

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1 PBQ&D, "Center City Pedestrian Circulation and Goods Movement Study", September, 1980. Data obtained in November, 1979. Six-minute sample counts were conducted and expanded to one hour volumes.

Heavy crosswalk volumes along Market Street affect intersection traffic operation. Vehicle turning movements are impeded by large pedestrian crossing volumes which cause back-ups and traffic delays. Crosswalk volumes for several intersections are summarized in Table III-8. The impact of varying pedestrian volumes on intersection capacity in terms of passenger car equivalents is summarized in the Technical Appendix.

Island-Related Pedestrian Accidents

Pedestrian accidents involving the passenger safety islands have represented 14 percent of all pedestrian accidents along Market Street.[1] In the majority of cases, accidents occurred as a result of passengers stepping off the island while alighting and because of insufficient island space (see Technical Appendix for accident record details). Other frequent causes for accidents were jaywalkers not observing traffic while trying to use islands for refuge as they cross Market or improperly accessing the loading islands (not using crosswalks). The present island platform tends to encourage jaywalking by providing an unobstructed intermediate refuge while crossing Market Street. Where this activity can occur, the potential for pedestrian accidents is amplified.

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1 "Pedestrian Safety Study", Department of City Planning, developed from police reports between 1975 and 1979.

Table III-8
MARKET STREET CROSSWALK VOLUMES[1]

Location	Crosswalk	Noon Hour	PM Peak
Fremont Street	E	-	2,160
First Street	E	-	2,850
Second Street	W	-	660
Montgomery Street	E	-	1,400
Third Street	W	-	1,000
Fourth Street	E	686	586
	W	412	352
Powell		2,341	1,994
Fifth	E	927	792
	W	622	532
Sixth	E	557	476
	W	331	284
Seventh	E	801	684
	W	461	394
UN Plaza		-	345
Eighth	E	-	310

1 Data aggregated from various San Francisco Environmental Impact Reports.

CHAPTER IV
ANALYSIS CRITERIA/METHODOLOGY

Developing an operational plan required the analysis of several different criteria concerning transit service and traffic flow. Streetcar operation, transit stop locations, island design and street geometric issues were resolved within a restrictive set of physical, policy, and operational constraints. In addition, design criteria for bus shelters, overhead wire poles, along with crosswalks/curbs and gutters were evaluated. The following sections identify methodology used to develop with streetcar and without streetcar plans for Market Street.

STREETCAR OPERATION

Streetcar operation was assumed to serve the Civic Center area along Market Street and continuing on to the Fisherman's Wharf/Fort Mason area via the Embarcadero. Specific criteria concerning streetcar service are shown below.

- Historic streetcars would be used.
- Streetcars would not be coupled together.
- Uniform headways would be maintained throughout the day.

TRANSIT STOP LOCATIONS

Market Street bus stop locations were selected to maximize operational and passenger convenience. In most cases all criteria were met; however, to accommodate some overriding physical constraints in certain locations, other policy and/or operational concerns were compromised.

Physical

- Widening of Market Street should be avoided except where a functional plan cannot be developed. Any widening must minimize both length and depth of intrusion.

- Island stops in opposite directions should never be located adjacent to one another to reduce the need for street widening.

- Locating island stops next to BART vent shafts should be avoided. Large, unpredictable flows of air occur when BART vents are utilized containing particulates and debris. With islands adjacent to vents, this air flow would be undesirable for passenger safety and comfort.

- Island stops should not infringe upon the air space of BART ventilation shafts. Discussions with BART, California Public Utilities Commission and design consultants indicate any street-level impediment to air flow out of the vents would be highly undesirable and would reduce functional requirements.[1] BART indicated that where vents have been modified to accommodate street-level amenities, performance has been unsatisfactory.

- Curbside stops should be coordinated, where possible, with existing shelter locations.

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[1] Discussions with Bill Schneider, BART Manager of Design and State of California, Public Utilities Commission, Transit District Safety Branch.

Policy

- Stops should be spaced at intervals of approximately 600 to 900 feet.[1]
- At least 100 feet of curb space should be provided for bus stops.
- With island and curb operation, group lines in the outbound direction and segregate Transbay Terminal and Ferry Building routes inbound.

Operational

- To reduce potential for transit delay, stops should be located such that effective signal timing for transit progression can be developed.
- Place stops away from areas of traffic congestion, especially where right turning traffic frequently backs up creating potential transit delays.
- Conflicts with truck loading zones should be avoided. Islands should not be placed adjacent to loading zones to minimize potential curb-lane blockage.
- Attempt to locate stops where high passenger demand can efficiently access and transfer to system. Try to place stops closer in financial district to minimize boarding/alighting concentrations.
- Minimize use of far side island stops which increase potential for traffic accidents (liability) and restrict maneuvering of truck and auto traffic turning onto Market Street.

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[1] San Francisco Municipal Railway, "Five Year Plan: 1980-85", April 1, 1980, page 22.

- Do not place curbside stops where heavy sidewalk pedestrian volumes would interfere with waiting bus patrons or boarding/alighting activities.

- Locate island and curbside stops in a staggered fashion where possible to reduce potential delays. Positioning stops side-by-side would cause transit delays when buses are unable to reach stops due to small traffic queues.

Bus Route Allocations: Curb/Island

MUNI bus routes were allocated to both center and curb travel lanes along Market Street. The assignment of transit service between curb and island lessens concentrations of bus volumes and passenger loading activity along Market Street between First and Seventh Streets. Specific route allocations were determined using the following criteria:

- Balance bus and passenger activity to avoid concentrations.

- Separate routes which turn off Market Street from those which stay on Market Street west of Eighth Street. This minimizes weaving of transit routes, especially in the outbound direction and at First Street in the inbound direction.

- Where weaving of transit routes occurs, complicated overhead wiring arrangement should be avoided by weaving diesel coach lines.

- Coordinate route allocation with ongoing studies.[1]

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1 "Market Street Guideway Project, Rehabilitation of Trolley Overhead", Tudor Engineers.

LOADING ISLAND DESIGN

Additional trolley and diesel coach service is proposed for Market Street (see Table III-5) and has become necessary with continued expansion of the financial district. Table IV-1 shows the existing and proposed number of buses along segments of Market Street during the evening peak hour. The maximum number of scheduled buses occurs between Fremont and Sutter Streets. The 38 line presently utilizes the existing passenger loading islands which leaves 84 buses operating on the curb in the peak hour.[1]

Table IV-1
EVENING PEAK HOUR SCHEDULE
Transit Vehicle Volumes

Westbound Street Segment	Existing[1]	Proposed[2]
Steuart to Fremont	59	73
Fremont to Sutter	122	125
Sutter to Geary	115[3]	103
Geary to Fifth	77[3]	85
Fifth to Turk	99	97
Turk to McAllister	69	78
McAllister to Hayes	54	63
Hayes to Eleventh	54	51
Eleventh to Van Ness	42	41

1 Based upon schedule revision effective January 27, 1982.

2 MUNI, ABAG, MTC and SFDCP, "Methodology for Projecting Future MUNI Demand and Vehicle Requirements", June 1982. 1991 Scenario IV (no-growth) developed by MUNI Planning Staff.

3 Numbers relate to westbound volumes. Volumes are similar eastbound; however, the 66 line adds four buses between Fifth and Second and the 16X and 72X continue from Fifth to Fourth.

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1 Although 99 buses presently operate along the curb between Fifth and Turk Streets, no bus stops are located on this block.

Originally, the Market Street Reconstruction and Beautification Project did not include any passenger loading islands. However, with proposed levels of transit service, 125 buses would be scheduled to operate in the curb lane during the peak hour. With curbside bus loading and mixed vehicle traffic, the maximum ideal capacity for transit vehicles in the peak hour would be 120 buses per hour[1] without significant reductions in automobile traffic. Therefore, without operational changes, Market Street would not have adequate transit capacity.

To increase Market Street's transit carrying capacity, platoon (or "skip-stop") operation and two-lane transit service with curb and island stops were considered. Since many of the MUNI bus routes utilize trolley coaches with overhead wiring, platoon operation would be nearly impossible due to physical wiring constraints (this would eliminate the ability of buses to "leap-frog" in a skip-stop operation). In addition, MUNI staff has indicated the headways between routes vary sufficiently to make it impractical to dispatch platoons of buses in any fixed numerical sequence.[2] By utilizing both curb and center travel lanes in parallel transit operation, Market Street would be able to accommodate 200 to 240 buses per hour in mixed flow (for analysis, 200 buses per hour was used). Parallel transit operation requires the provision of passenger loading islands and overhead electrification of each lane.[3] Balancing bus routes between curb and island stops would generate a 67 percent increase in Market Street transit capacity. Since platoon operation would not be possible on Market Street, parallel transit service was selected as the most effective means of increasing Market Street bus capacity.

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1 Based upon two buses clearing <u>each</u> green signal phase (assumed 60 second cycle length) with adequate signal progression established for transit. This coincides with "Bus Use of Highways: Planning and Design Guidelines", Transportation Research Board, NCHRP Report No. 155, 1975, page 38.

2 Criteria established at Fort Mason Workshop.

3 Part of "Market Street Guideway Project, Rehabilitation of Trolley Overhead", Tudor Engineers.

With parallel transit operation, development of new passenger loading islands was analyzed. Passenger loading island design criteria were developed which include dimensions, safety and appearance.

Dimensions

Width. Island widths must compromise passenger comfort with physical street size constraints. Wide islands with liberal passenger standing areas could be designed; however, significant widening of the proposed Market Street cross section would be required. By maintaining an island width of six or seven feet, the proposed Market Street cross section would not need to be increased. A seven foot island would adequately serve evening peak hour passenger accumulations with sufficient width. In the morning peak period, the predominant passenger activity is alighting, where queues of pedestrians waiting for buses is smaller. A six foot island (considered minimum width criteria for platform loading[1]) could comfortably serve passenger demand.

Length. Island lengths should provide a comfortable passenger waiting area and be capable of serving two stopped transit vehicles (in any combination of standard coaches, articulated buses and/or streetcars). Since articulated buses are the longest vehicles which must be served, two-60 foot buses would require approximately 110 feet of lineal curb space for loading. The 10 foot difference from 120 feet (2 x 60') accounts for the 12 to 17 foot distance from the back bumper to the last set of alighting doors on an articulated bus which would not require platform space. Where far-side islands are provided and two articulated buses are stopped at a passenger platform, the end of the second articulated coach would extend 10 feet into the crosswalk area.

Passenger accumulation data was analyzed to establish passenger comfort conditions during peak loading. Existing data for waiting and alighting passengers was projected into future service conditions and then split between island and curb stops according to proposed route assignments (discussed in Chapter V). The maximum island accumulation

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1 Established by Muni at Fort Mason Workshop.

used to establish island length criteria was 50 persons boarding and alighting at the Sutter/Sansome island during the westbound evening peak hour. Using level of service "C" conditions for queueing pedestrians (see Figure IV-1) 0.9 square meters (9.684 square feet) would be provided for each person. Since the width of westbound islands would be seven feet, the length can be determined as shown below:

Maximum Accumulation	x	Level of Service "C" Space Requirement	/	Effective Island Width[1]	=	Island Length
50 persons	x	9.684 sq. ft/person	/	(7'-1.5'-1.16')	=	111 feet

Therefore, for design purposes, Market Street islands should be 110 feet long.

Safety

Since passenger safety has been a problem with the existing five foot islands (see Chapter III and Technical Appendix for details), design criteria were established to improve both passenger and driver safety. Islands would always be associated with crosswalks at signalized intersections to provide safe pedestrian access from curb to platform. Other design elements which were analyzed include island width, island barriers and driver safety.

Island Width. All westbound islands would be seven feet wide and all eastbound islands six feet wide. Increased island widths would reduce some of the dangerous overcrowding which occurs presently.

Island Barriers. To protect passengers from moving vehicle traffic in the curb lane, island barriers should be installed to prevent random pedestrian access to or from the island from the sidewalk (jaywalking) and protect passengers from being forced into travel lanes by overcrowding. Presently, cyclone fences are used for barriers, which are

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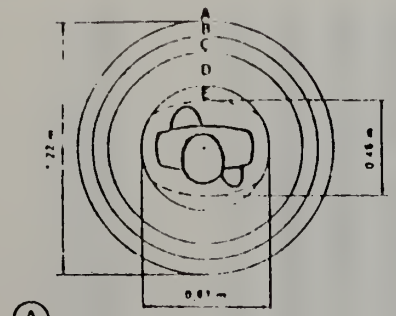
1 Effective island width = width - edge buffer (1'6" typical) - width of proposed island safety barrier (1'2").

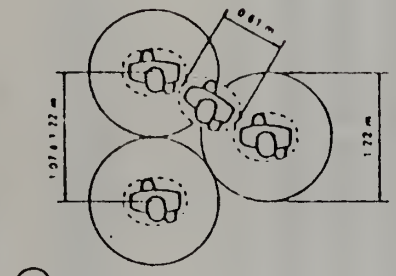


(A) Free circulation

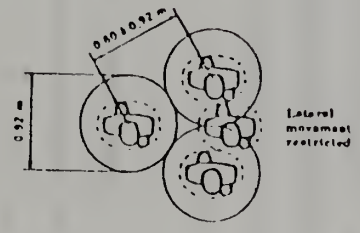
Levels of Service For Queuing

Level of Service	Definition	Diameter (m)	Occupied space (m^2)
A	Free circulation	> 1.22	
B	Restricted circulation	1.07 - 1.22	1.11
C	Personal comfort zone	0.92 - 1.01	0.90
D	No touch zone	0.81 - 0.92	0.69
E	Touch zone	< 0.81	0.20
F	Body ellipse	0.61 x 0.46	0.22

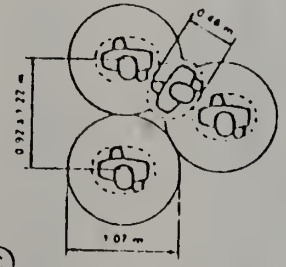
Source: Fruin and Pushalik/Cleveland



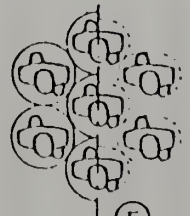
(B) Restricted circulation



(D) No touch zone



(C) Personal comfort zone



(E) Touch zone (F) Body ellipse

Level of Service	Definition	Description
A	Free Circulation Zone	Inter-person spacing of 4 feet or more allowing for free circulation through queuing areas without disturbing others.
B	Restricted Circulation Zone	Inter-person spacing of 3.5 to 4 feet allowing for restricted circulation through a queue.
C	Personal Comfort Zone	Inter-person spacing of 3 to 3.5 feet, space is provided for standing and restricted circulation through the the queueing area by disturbing others; it is within the range of personal comfort body buffer zone established by psychological experiments.
D	No Touch Zone	Inter-person spacing of 2 to 3 feet providing for standing without personal contacts with others, but circulation through the queueing area is severely restricted and forward movement is possible only as a group.
E	Touch Zone	Inter-person spacing of 2 feet or less, space is provided for standing but personal contacts with others is unavoidable, no circulation is possible through the queueing area.
F	The Body Ellipse	Space occupancy of 2 square feet per person or less, standing for short lengths of time is possible, but close unavoidable contact with surrounding standees cause physical and psychological discomfort, in large crowds the possibility of panic exists.

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FIGURE IV - 1

COMFORT AND LEVELS OF SERVICE OF QUEUING PEDESTRIANS

extremely vunerable to damage from vehicle traffic. The existing fences are in various states of disrepair.

At the Fort Mason Workshop it was decided to develop a barrier with low maintenance qualities which blends into the Market Street Beautification Program, at the expense of cost savings compared to the cyclone fence. Since a barrier of this type would probably be constructed of concrete or granite, vehicle safety must be considered.

Driver Safety. To reduce the hazards of loading islands to drivers, lane dividers, driver-alerting pavement textures and signs should be developed. It is important that these devices do not, in turn, cause additional hazards to pedestrians or drivers.

Design of the island barrier should include safety features to reduce serious accident potential. Lane dividers and driver alerting pavement textures are passive safety features which are necessary. A Jersey-style barrier should be incorporated into the island barrier to reduce vehicle impact potential and protect the island. In addition, to protect drivers from serious head-on collisions with the concrete/granite island, an energy-attenuator should be incorporated into the bulkhead of the island.

Appearance

Since passenger loading islands were not part of the original Market Street Reconstruction and Beautification Project, every effort should be made to blend this new element into the proposed plan. However, since funding for final Market Street construction will be very limited, compromises between architectural appearance and costs should be sought where significant savings can be realized by using different materials.

STREET GEOMETRICS

The proposed Market Street cross section would consist of three elements:[1] (1) two curbside travel lanes; (2) two center lanes; and (3) passenger islands. Roadway space must be allocated to each element to adequately serve their intended use without requiring street widening.

Curbside Travel Lanes

Transit service, trucks and passenger cars should all be provided comfortable and safe operating space adjacent to the curb. Since passenger loading islands will be provided, curb travel lanes would be placed between sidewalk curbs and passenger loading island barriers. To allow adequate room for trucks to maneuver into and out of curb lanes from cross streets and provide adequate room for heavy bus operations, curbside travel lanes should be a minimum of 12 feet wide. Where the curb lane is not adjacent to a passenger loading island, an 11 foot travel lane would be acceptable.

Center Lanes

For streetcar operation, the minimum dimension for both center lanes to accommodate eastbound and westbound tracks would be 21 feet (10.5 feet in each direction). This width would be held with or without streetcars to provide trolley and diesel coach service.

Passenger Islands

As previously discussed, passenger loading islands on Market Street should be six to seven feet wide. Islands provided in the westbound direction should be seven feet and islands in the eastbound direction should be six feet.

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1 Between Steuart Street and Eighth Street.

The original Market Street Reconstruction and Beautification Project proposed a 50 foot cross section with a 13 foot curb lane adjacent to a 12 foot center lane in each direction. Passenger loading islands were not provided in this plan and, in fact, extensive transit use for Market Street was not anticipated. (It was assumed with MUNI Metro that all surface transit would be replaced or moved to arterials south of Market Street.) With streetcars, large transit volumes and the need for loading islands where Market Street is finished at 50 feet, compromises between curbside travel lane widths and island widths would be required or street widening would become necessary.

BUS SHELTER CRITERIA

Modifications to the existing transit shelters must be made both to achieve desired functional use and to blend into the existing street design. The following criteria reflect a concern for these two issues:

- Shelter modifications should improve the weather protection currently afforded. This should be achieved by adding screening on at least two sides to stop wind and wind-blown rain.

- Safety of MUNI patrons must be considered. Any partitions added to the shelters for this purpose should be transparent to facilitate surveillance from outside patrols.

- The configuration of the shelter should ensure more than one means of exit for safety.

- Materials used to modify shelters should be drawn from those already in use on the street in order to ensure visual consistency. In particular, bronze posts can be used to create the enclosure, much as they are used on the existing telephone and elevator enclosures. This bronze material can be replicated inside the shelter for railings for leaning.

- Glass should be used for partitions in order to ensure durability, ease graffiti/poster removal and allow surveillance.

- Any partition added to the existing shelter should be raised off the actual paving (except for vertical support members) in order to facilitate the washing of the sidewalk and to avoid the accumulation of trash within the shelter enclosure.

POLE DESIGN CRITERIA

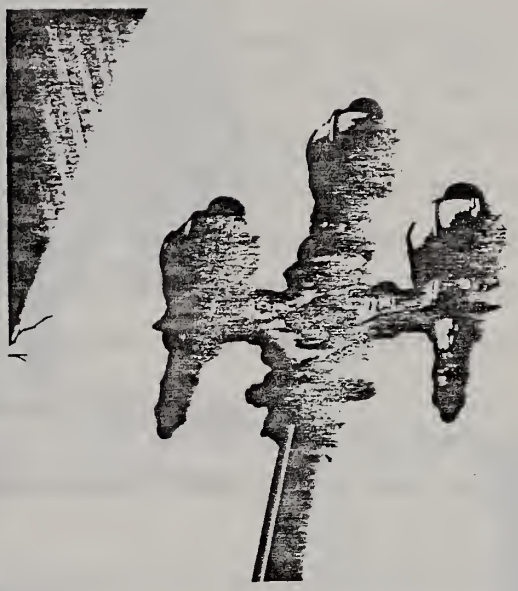
The renovation of the trolley and streetcar overhead along Market Street requires that a long term decision finally be made as to the means of supporting the overhead system. The following design criteria have been developed to guide the ultimate design of the poles and to aid in cost estimation.

Pole Appearance

A range of possible design solutions for the poles exists, varying from a highly ornate, Path of Gold type pole to a totally plain utilitarian pole.

The appearance of the pole should be considered in light of the design of the other vertical elements on the street. The existing Path of Golds are highly ornate, with large bases, a porcelainized finish, and highly detailed luminaries and top (Figure IV-2).

The use of the existing Path of Gold poles to support the overhead wires would not be structurally possible. Prior to the Market Street Reconstruction and Beautification Project, Path of Gold poles had been created by adding ornamental castings, paint and luminaries to trolley poles. Since policy at the time of the original Beautification Project indicated that no trolley overhead would be required on Market Street, the old Path of Gold were replaced with new porcelainized ornamental versions, with shallower foundations and with plaster castings for ornamentation. These existing poles cannot be modified in any reasonable fashion to accommodate trolley overhead supports.



Path of Gold Top

Path of Gold Base

Source: Ripley/Bogatay

FIGURE IV-2
PATH OF GOLD

Other poles which support signal mastarms or signage are plain poles with no embellishments. The Path of Gold poles should remain the principal visual element of Market Street. Throughout San Francisco there are fine examples of light, signal and wire support poles which are modestly embellished with classical ornament (Figure IV-3). These poles tend to add a bit of texture and interest to the streets which they occupy. These types of poles can be applied to Market Street creating an element which would be of visual interest without being overwhelming.

The elements which comprise the design of the pole include: (1) the base or lack thereof; (2) the actual pole itself; (3) the top of the pole; (4) possible colors or finishes.

Based upon examination of these elements the following design criteria for the poles have been developed:

Stem:

- The poles should taper and be of uniform cross section if possible, with differences in structural requirements met by varying internal thickness. If this proves too costly or structurally infeasible, poles should be of no more than two dimensions, which would ideally be close enough to appear the same.

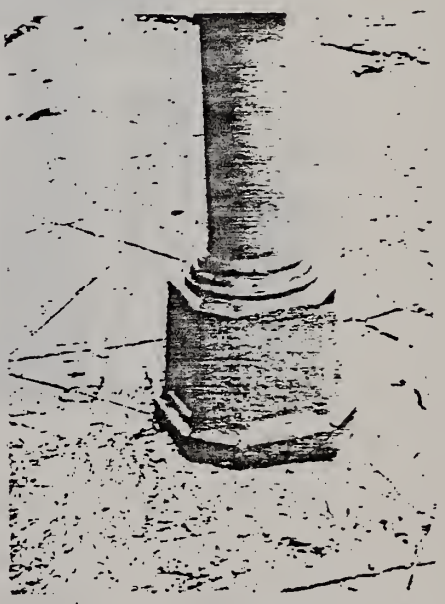
- The pole should otherwise be plain, with no fluting or other detail.

- The pole height should be approximately 24 to 28 feet, depending on the final location and the functional requirements of the overhead system.

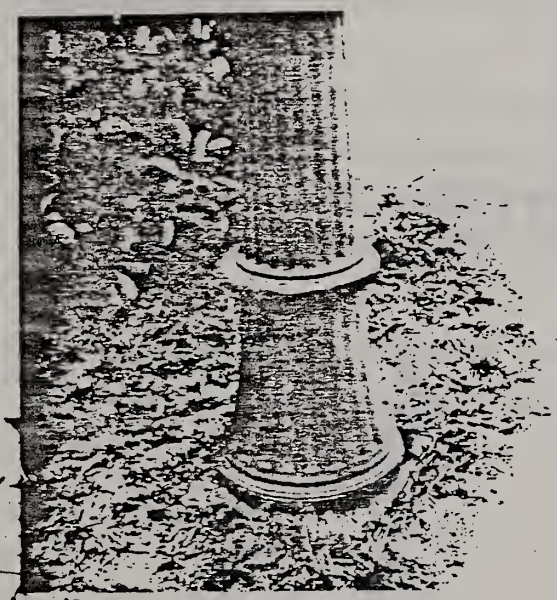
Base:

- In order to fit into the established theme and existing framework of the street, the poles should bear some resemblance to the Path of Gold poles without competing with them visually. Therefore, the base of the

Symetry of existing pole placements on Market Street



Octagonal Base



Circular Base

Brick cut out for pole

FIGURE IV-4
POLE DESIGN/PLACEMENT

Source: Ripley/Bogatay

pole should be completed with some kind of base cap, smaller and much less ornate than the Path of Gold but similar to others throughout the City. This base cap would aid in disguising structural connections required at the base of the pole as well.

- The base may be octagonal as are the Paths of Gold (Figure IV-4). A 16 or 20 inch base would be required depending on the size of pole dictated by structural requirements. The pole itself should not exceed 12 inches at the base.

- The poles should be located consistently within the sidewalk depth, ideally between the two rows of trees (see Location Criteria).

- By utilizing a 16 or 20 inch base, the poles could be integrated into the 4 inch module established by the brick paving, rather than haphazardly placed in the sidewalk. The base could be placed within the sidewalk without special brickwork (see Figure IV-4).

- The base could probably be cast either from molds or based on existing concepts. It should be no more than 12 to 18 inches high and simple in design.

Top:

- The top of the poles should be similarly understated. This could be accomplished with some kind of simple ornamental detail or with a simple cap. Design of the ornamental detail might draw upon the Paths of Gold or other poles in San Francisco for inspiration.

- The color of the pole should be related to existing materials and colors along Market Street. A blue similar to the Path of Gold or a bronze similar to details of shelters and other furniture would be appropriate.

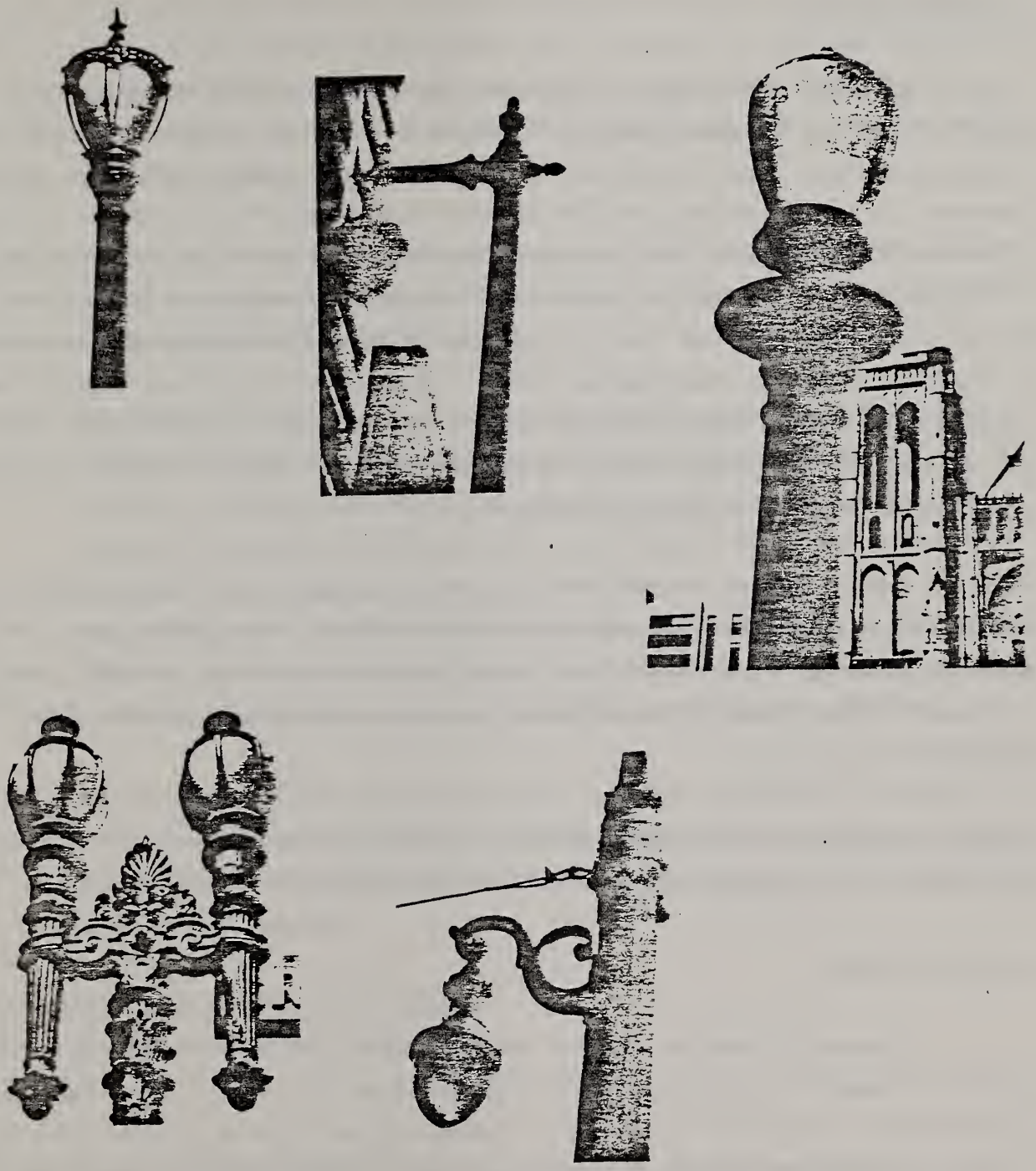


FIGURE IV-3
EXAMPLES OF DIFFERENT POLES

Source: Ripley/Bogatay

Poles and Eyebolts

In order to reduce the number of overhead support poles required along the length of Market Street and to reduce possible clutter at intersections, eyebolts should be used wherever possible, especially at corners. The use of eyebolts would be directly dependent on existing building condition and on future development scenarios. A survey of Market Street indicates that the eastern end of Market Street, between Steuart and Fifth Streets is much more highly developed in permanent uses than is the remainder of the street, and therefore has a greater potential for accommodating a higher percentage of eyebolts. However, open spaces, plazas and spaces resulting from angled streets crossing Market Street create situations where no building would be available on which to put an eyebolt. It appears that in this eastern area, at most 75 percent of support requirements could be realized with eyebolts.

West of Fifth Street fewer new buildings are in evidence and many buildings will undoubtedly be demolished for new construction within the foreseeable future. In this area it appears that substantially fewer than 50 percent of the supports could be realized by eyebolts. Owner cooperation and building structural unsuitability would reduce these percentages even more.

Eyebolts would be located to interfere as minimally as possible with the visual appearance of the buildings and would be located to respect historic features.

Location Criteria

- Whenever possible, building eyebolts should be used to support overhead wires.

- When use of poles is necessary, their location should be as consistent as possible along the length of Market Street, matching in some fashion the rhythms established by the other street furniture elements (Paths of Gold, trees, shelters).

- At corners, especially where special conditions occur, consistency might be difficult to maintain and visual clutter may occur. Wherever possible at these locations, eyebolts should be used in order to avoid locating poles at a corner where they might interfere with pedestrian movement and reduce visibility of pedestrians by vehicles.

- At corners where it is not possible to use eyebolts, poles should be placed within the sidewalk space of the side street in order to avoid visual clutter within the Market Street streetscape.

- Pole locations should be systemized both longitudinally along the length of the street as well as within the depth of the sidewalk between the building and curb. The best location for the poles would be between the two rows of trees, in the same line as the Paths of Gold (Figure IV-4). Locating poles in the front row of trees would necessitate relocation in cases where tree rows become discontinuous due to truck loading area indentations. Locating the poles within the back row of trees, closest to the buildings would require a greater span across the street and therefore a significantly taller pole.

- Locating poles in the center line of the trees may occasionally conflict with other street furniture which is located in the same zone, such as the transit shelters, benches and information kiosks. In these cases, eyebolts should be used if at all possible.

CROSSWALK/CURB AND GUTTER DESIGN

As designed in the original Market Street Beautification Project, the brick crosswalks and granite curbs are integral design elements within the total scheme. The crosswalks act as an extension of the sidewalk space, becoming a "pedestrian precinct" to motorists and pedestrians. This is very important both as a design feature and in terms of safety. Irregularities in location of crosswalks generated by the meeting of the two street grids make it difficult for vehicle operators to identify crosswalk locations without this color and material change.

Surveys of existing crosswalks and granite curb and gutters indicates that failures of brick pavers occurs frequently (see Technical Appendix for investigation of brick and granite breakup). Any redesign of the crosswalks must address the preceding issues in addition to solving the breakup problems. The following preliminary design criteria should be used to guide future design:

- The use of brick and granite in the crosswalks remains the best solution since these materials are consistent with the overall design concept and function very well as a visual indication of the pedestrian precinct. Every effort should therefore be made to retain these materials.

- If the use of brick pavers proves to be infeasible, and if interlocking pavers meet performance requirements, design of the ultimate configuration should respond to the following:

  - The interlocking pavers chosen should not attempt to look like brick. Red tinted concrete pavers would only accentuate the incongruity between the materials.

  - Since we cannot adequately replicate brick, the paving for the crosswalk should be related instead to the character of the traveled way surface and to the character of the linkage elements: curbs, gutters and edging strips.

  - The paving color selected should be adequately differentiated from the surrounding traveled way surface (presumably remaining asphalt) to read as a special area to the motorist. This can be accomplished through the careful consideration of color. As an example a light grey color would read as distinctly different from the surrounding black and would present opportunities to visually relate to the curbs, gutters, and edgings.

- If granite gutter and edging can be redesigned to function adequately, then granite should be used to edge the crosswalk paving and for curbs and gutters. If infeasible, a special edging piece of the interlocking pavers should be selected. Consideration should then be given to relating the crosswalk edging to the gutters and curbs in terms of color, material and pattern.

- It appears that the granite gutter can be redesigned to function adequately, despite some breakup which has been experienced. By removing several rows of granite pavers, thus narrowing the gutter, breakup can be avoided as buses do not normally encroach that close to the curb. Similarly, at truck loading areas, where granite breakup has occurred at the roadway edge, narrowing the granite area by removing several rows of pavers should eliminate the loading condition from buses, which seems to be the source of the problem.

The continuing use of granite as a trim material for Market Street should be carefully considered. In quality and appearance it is far superior to any other material and is consistent with the other high quality and materials in use such as the bronze. If brick and granite prove infeasible in the crosswalks and are replaced with interlocking pavers, granite can be continued for curb and gutter use. In this case it may be appropriate to use a form of the interlocking paver to edge the new crosswalks. New loading islands can be constructed either of granite and brick or of interlocking pavers and concrete.

CHAPTER V
MARKET STREET ALTERNATIVE PLANS

At the outset of this study, a workshop was conducted to facilitate two basic objectives. First, Tudor Engineers, consultants for the Market Street Overhead Wire Project, required input from this study to allow them to continue their project. Secondly, a wide variety of alternatives, concerning such issues as streetcar operation/trackage location, travel lane configurations, and passenger loading island needs, were available for evaluation as part of the Market Street Design Project. Some of these alternatives were felt to be impractical while others were not. To reduce the total number of Market Street alternatives and address the needs of the Tudor study, a two-day workshop was conducted. Representatives from many City of San Francisco departments attended the workshop and provided extensive input.

The following sections discuss the findings of the workshop in relationship to potential Market Street alternatives. When more detailed analysis was suggested to confirm the basic findings additional analysis by the consultant team was undertaken. These secondary, more conclusive evaluations are described elsewhere in this report. To focus the workshop sessions, a list of 14 questions was developed. The questions, as well as the agreed upon answers, are included in the Technical Appendix of this report. Throughout this study, it has been the goal of the entire project team to develop an operations plan(s) for Market Street that has the highest benefit-cost ratio while providing a feasible and functional configuration for Market Street.

STREETCAR OPERATIONS

Three conditions for streetcar operation and location on Market Street were considered: (1) operation within the sidewalk; (2) along the curb; or (3) in the center of the street. Streetcar operation within the center of Market Street was selected. Operation within the sidewalk would be extremely expensive, requiring major relocation of sidewalk

amenities, utilities, and furnishings and would probably require the widening of the sidewalk to accommodate pedestrian flows. Streetcar operation within the curb lane was also eliminated. Within the curb there are numerous utilities and underground access ways. Relocation of these utilities would be required to allow curb operation. Further, the street profile at cross street locations would be severely restrained with curb operation. The cost impacts associated with providing streetcar operations at locations other than in the center of Market Street are extremely significant.

TRAVEL LANE CONFIGURATION

The potential for operating one lane eastbound/two lanes westbound as well as two lanes in each direction were evaluated. Even in the off-loading eastbound direction, two lanes are needed as one cannot accommodate the projected vehicle demand levels at the curb. Two transit lanes are needed to ensure adequate travel lane capacity. Therefore, two travel lanes in each direction were assumed.

ISLANDS

Under any operational scenario islands are required to accommodate the projected vehicle headways along sections of Market Street. Three configurations for island placement were analyzed. These include:

- center platform loading island;
- opposing islands, nearside or far side inbound and outbound; and
- adjacent, side by side.

The central loading island option was eliminated because of the decision to use trolley coach operation in the center two lanes. Trolley coaches require island placement for right side vehicle loading. It is conceivable that west of Eighth Street or east of Fremont, central islands could be used if all trolley and diesel operations are allocated to the curb lane. This option will be most beneficial east of Fremont when Market Street has been completed. The use of central islands for streetcars down Market Street would eliminate the need to modify a major portion of the street surface.

The use of adjacent, side-by-side, islands was also eliminated, mainly due to excessive cost. To adequately accommodate islands, the minimum curb-to-curb street width would be 61 feet (21 foot two-way transit lane, plus two islands at 7 feet each, plus two curb lanes at 12 feet each). This configuration would require an 11 foot widening of the 50 foot finished street width of Market Street. Besides the cost of relocating most utilities and amenities within the sidewalk, this option would disallow any islands adjacent to BART escalators which are set back from the curb approximately 4 feet.

The use of opposing island locations is feasible; however, to provide adequate room to accommodate islands, the central travel lanes must weave from side to side of the street's centerline. Further, the use of a near side island stop allows the use of a near side island, if needed, in the opposite direction.

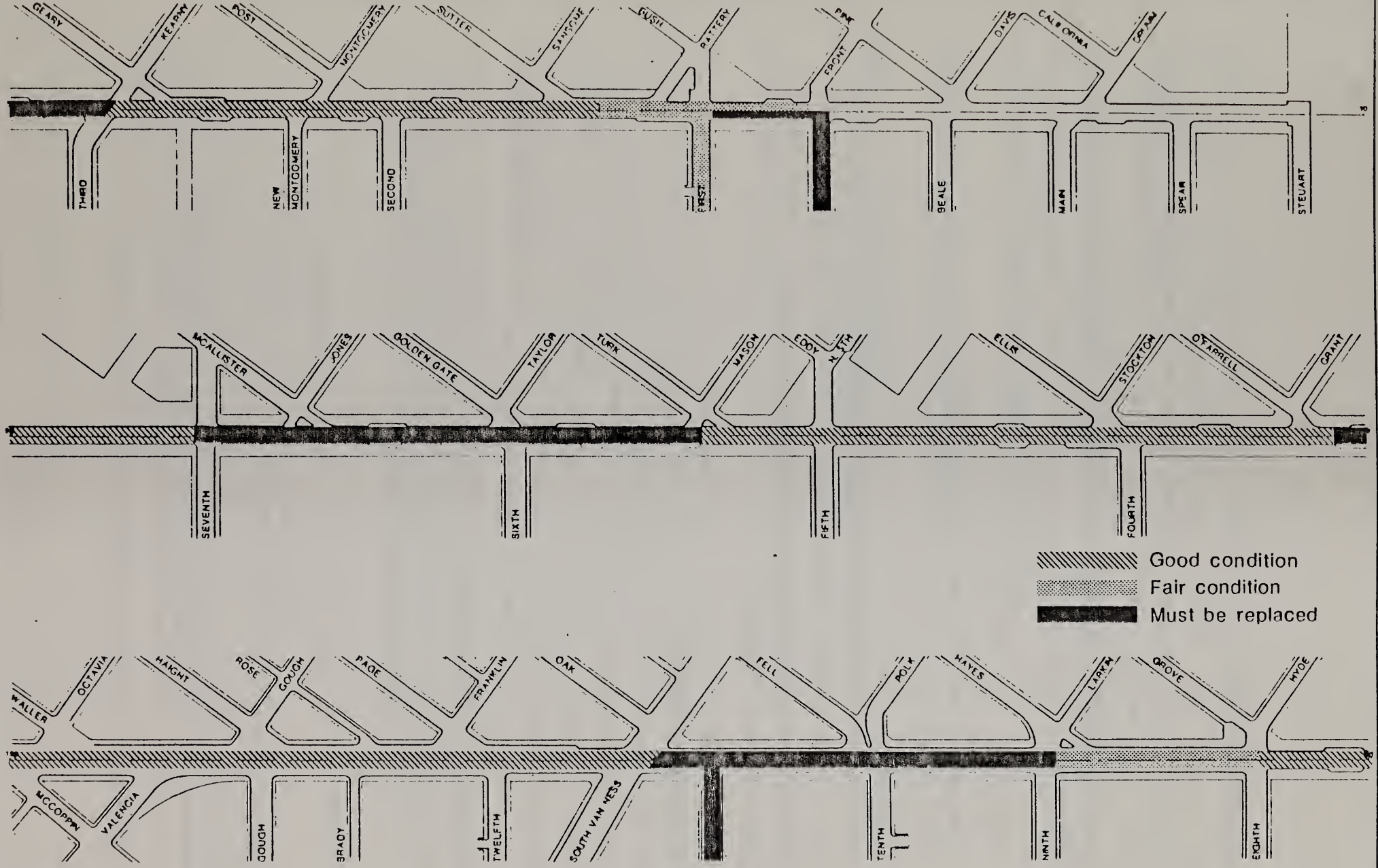
TRACKAGE OPTIONS

Three options regarding the provision of streetcar tracks along Market Street were considered. These were:

- retain all existing track;
- replace all existing track; and
- if good track exists, use it and replace all bad track sections.

An assessment of the existing trackage on Market Street from Duboce to the Transbay Terminal was conducted by MUNI. Portions of the existing track were considered in acceptable condition to provide low speed, low frequency revenue service. Other sections, including all existing special track sections and the "Y" turnback at 11th Street, need to be replaced. Due to the existence of bad track, the option to retain <u>all</u> existing track was eliminated. Figure V-1 shows condition of existing streetcar track.

The options of both replacing all existing track as well as retaining selected portions of the existing track were selected for further evaluation.



● **DKS Associates** ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V-1 **CONDITION OF EXISTING STREETCAR TRACKAGE**

SELECTED ALTERNATIVES

Ideally, two operating plans would be developed for Market Street, one with streetcars and one without. Because a signifcant portion of the existing trackage can be retained, a second streetcar alternative is presented. All three alternatives are being delineated in this report. They are:

- Alternative A (with streetcars--weave all tracks)
- Alternative B (without streetcars—weave lanes)
- Alternative C (with streetcars--keep good tracks/weave new track)

Besides the selected operating plans for Market Street operations, this study evaluated two other sets of alternatives. These additional alternatives include extensions of streetcar operations east of Fremont to the Embarcadero and west of Seventh Street to the Civic Center area (see Chapter VI).

ALTERNATIVES' CONSTRAINTS

A 51 foot curb-to-curb street cross section is recommended from Fremont west to Seventh Street. The existing 50 foot sections east of Fremont to the Justin Herman Plaza and between Seventh and Eighth would be maintained. If the streetcar alternative is selected and streetcar operations exist on these latter sections, the 50 foot section would be retained; however, this requires island or curb lane narrowing (two 10.3 foot center lanes adjacent to island, plus one 11 foot and one 12 foot curb lane, plus a 6 foot island). West of Eighth Street, the existing 68 foot cross section would be maintained.

ALTERNATIVES

Alternative A (with streetcars--weave all tracks)

To accommodate four travel lanes along Market Street, the center lanes must weave to the north and south to allow room for island loading zones. This condition is mandatory whether or not streetcars operate on Market Street. The weave requires a maximum off-

set of 4 feet. The resultant cross section is shown in Figure V-2. This figure compares the existing street configuration between Fremont and Seventh Streets to Alternatives A, B and C.

With Alternative A, new tracks throughout the entire length of Market Street east of Van Ness would be required. The 51 foot section would be created by reducing the 18-19 inch granite curb to 12 inches on both sides of Market Street.

Alternative B (without streetcars—weave lanes)

Option "B" is exactly the same as "A" except streetcar tracks are eliminated. The island and curb stop placements east of Eighth Street are identical.

Alternative C (with streetcars--keep good track/weave new track)

This alternative retains "good" track (see Figure V-1) which requires that the street be widened by 2 feet, 3 inches adjacent to the islands. The resultant cross section would be 54 feet. Where new track is needed, the new sections would weave within a 51 foot cross section similar to Alternative A.

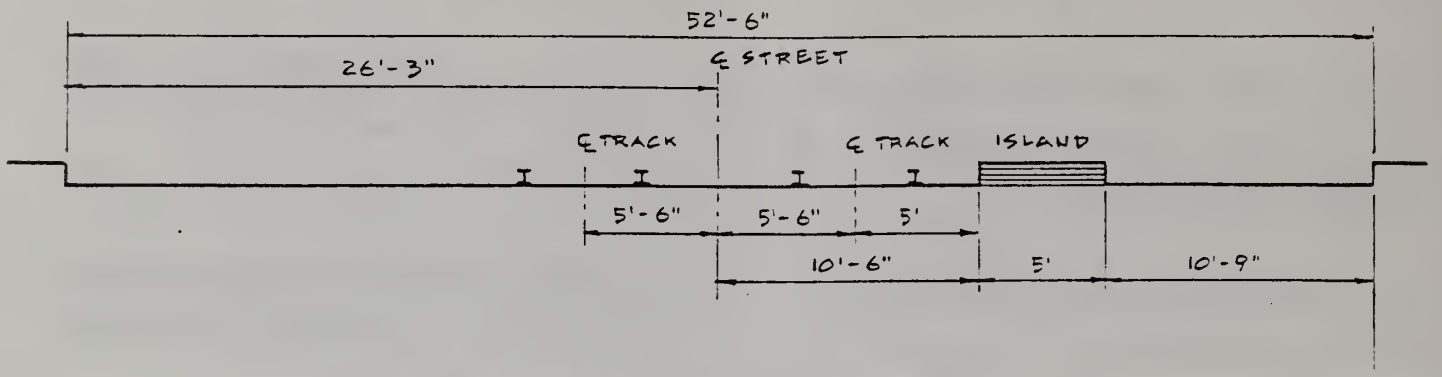
Prototypical Sections

Two prototypical sections of Market Street were analyzed in detail to best illustrate the design impacts, constraints and opportunities of each alternative to the existing street. The sections agreed upon by the Transportation Policy Group were:

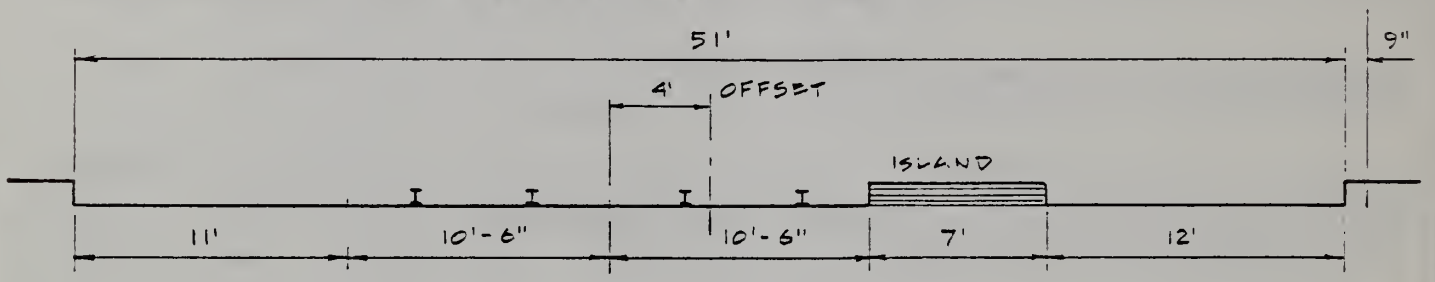
- East of Second Street to west of Third Street; and
- East of Eighth Street to west of Ninth Street.

No typical block exists along Market Street, each area is unique. However, these two sections present the types of issues which must be addressed along the entire length of the street.

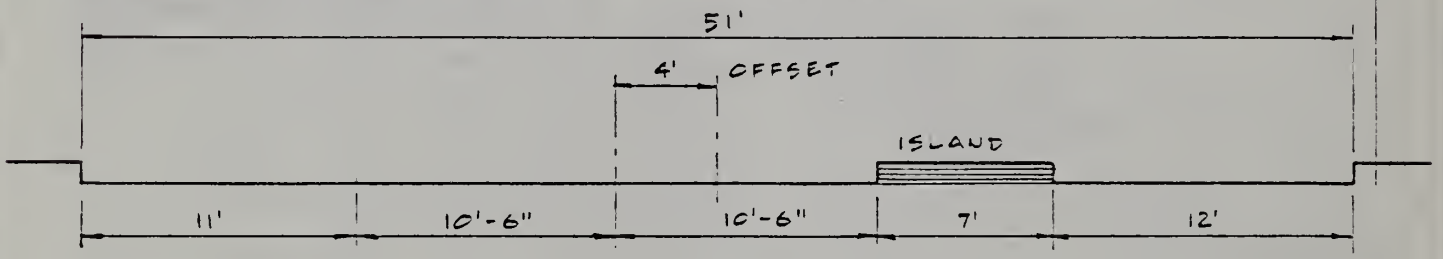
EXISTING STREET (Fremont to 7th street)



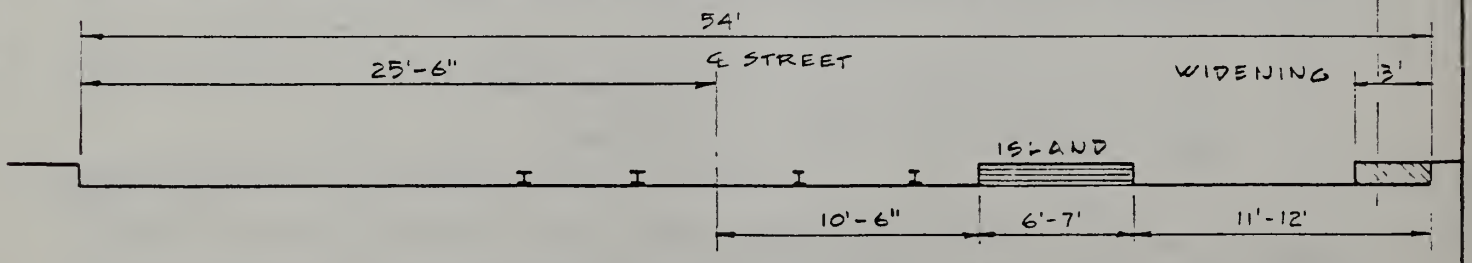
ALTERNATIVE A (with streetcars · weave all tracks)



ALTERNATIVE B (without streetcars · weave lanes)



ALTERNATIVE C (with streetcars · keep good track/weave new track)



SCALE 1/8" = 1'-0"

● DKS Associates ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V-2 **MARKET STREET CROSS SECTIONS ALTERNATIVES**

Second to Third. Figures V-3, V-4 and V-5 illustrate Alternatives A, B and C. For Alternatives A and B the existing tracks would be removed west of Second and Market to Third Street. The new central travel lanes need to weave across Third Street to accommodate the proposed islands. Eastbound between Third and New Montgomery there is no island, therefore, the travel lanes in both directions would not need to weave. East of Second Street the BART vent structure prohibits a weaving section around the proposed inbound far side island. To accommodate this island the following conditions must be met:

- Move the inbound streetcar rails for Alternative A south approximately 9 inches to provide a 5 foot distance between the center line of track and the edge of the island curb.

- Widen the street cross section adjacent to the BART entrance by approximately 3 feet to provide a 12 foot travel lane next to the 6 foot passenger loading island.

The travel lane configurations for both Alternative A and B are identical. In fact, Alternative A (with streetcars) and Alternative B (without streetcars) are identical except one requires trackage to be accommodated within the central travel lanes while the other does not.

Alternative C, which retains good track, requires weaving trackage west of Third Street because old trackage would need replacement (where old track is reconstructed, the new track would be weaved). East of Second Street, the same inbound widening conditions required for Alternatives A and B must be provided. It should be stressed that the only location where a far side island is proposed is east of Second Street in the inbound direction. Furthermore, it is the only location where street widening adjacent to a BART entrance is proposed. One additional location for a possible near side island could occur at Eighth Street; however, this condition is dependent upon which streetcar extension alternative is selected for the Civic Center area. The prototypical sections of Eighth and Ninth Streets show this condition.

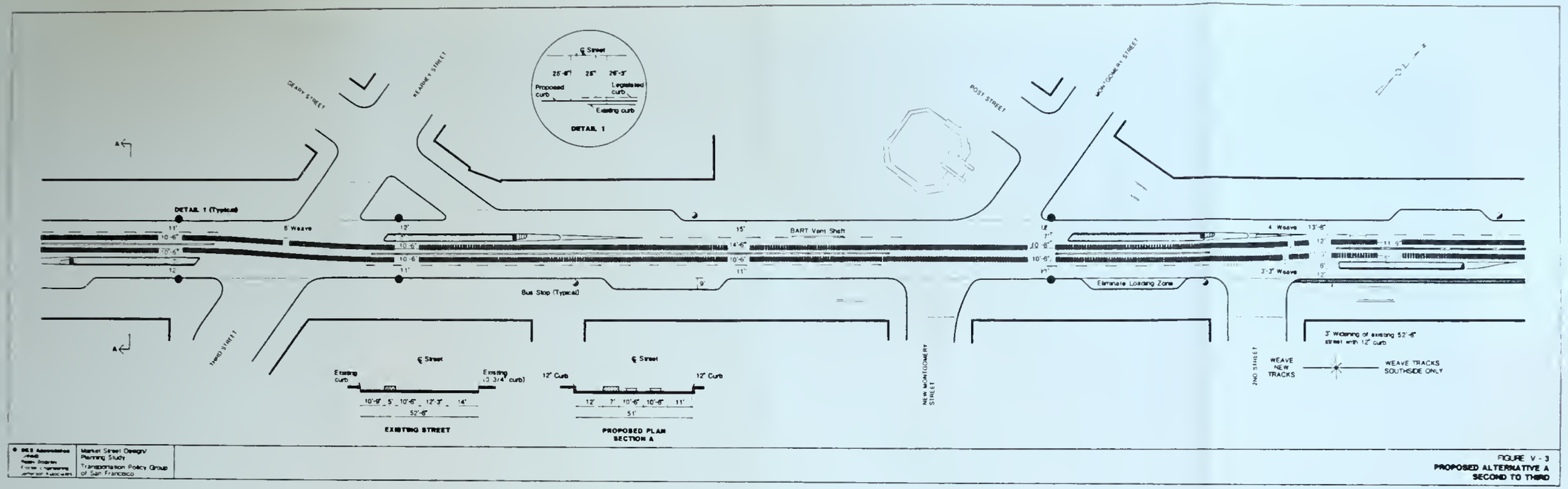


FIGURE V - 3
PROPOSED ALTERNATIVE A
SECOND TO THIRD

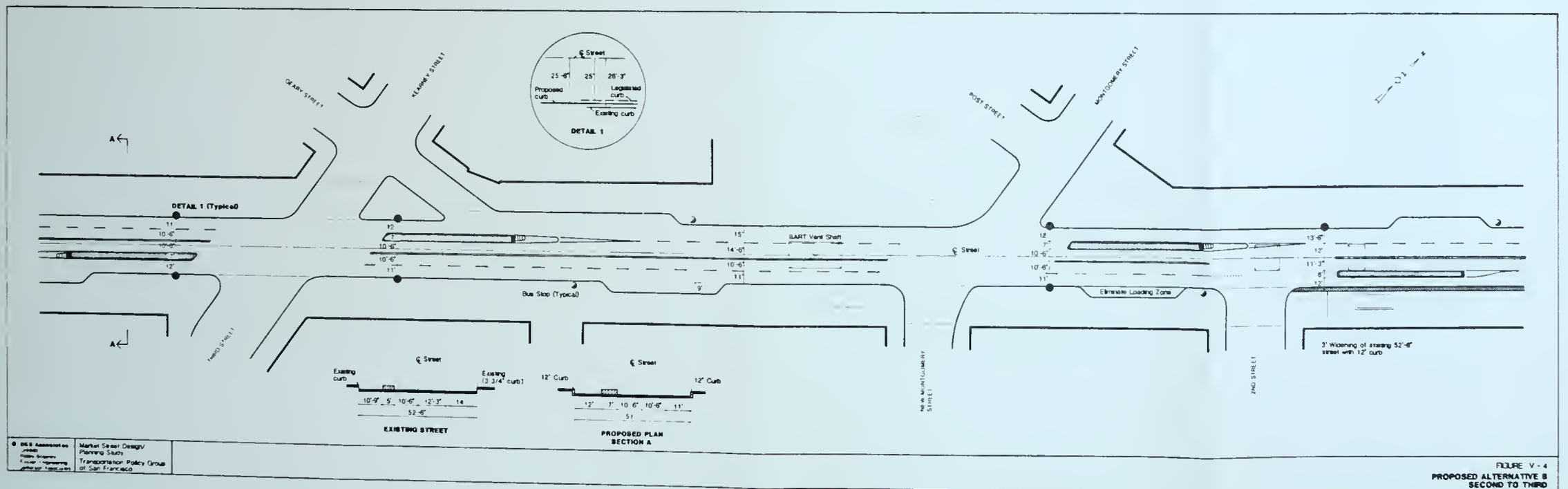


FIGURE V - 4
PROPOSED ALTERNATIVE B
SECOND TO THIRD

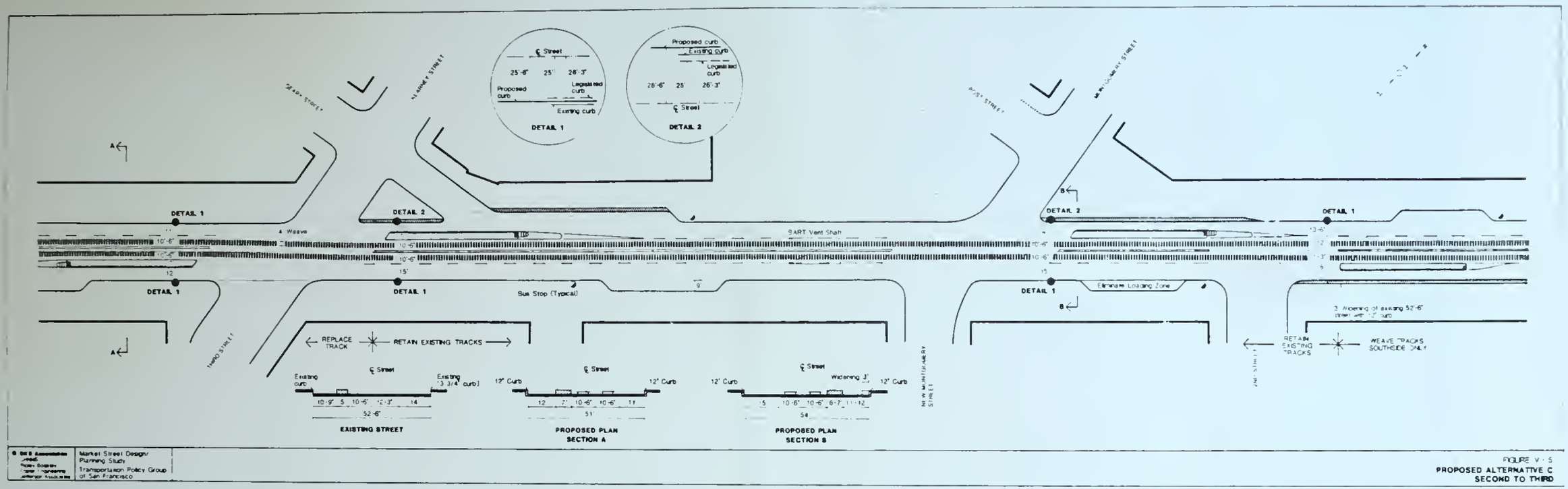


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FIGURE V - 5
PROPOSED ALTERNATIVE C
SECOND TO THIRD

Between Second and Third Streets where good track is retained, a street widening of 3 feet is required to provide adequate room for the curb travel lanes. Under normal conditions, as opposed to the unique case east of Second Street in the inbound direction, the curb travel lane would be 12 feet and the entire street would be 54 feet curb-to-curb.

Eighth to Ninth. Figures V-6 and V-7 illustrate the prototypical sections of Alternatives A, B and C from Eighth to Ninth Streets. Alternative B, within this section, simply requires the completion of the current Market Street project. The street geometrics are slightly changed to provide a four lane configuration east of Eighth Street and a six lane configuration west of Eighth Street.

Normally, between Seventh and Eighth Streets where Market Street is finished at 50 feet, the plan for streetcars would weave tracks to provide islands at Eighth Street. Unfortunately, east of Eighth and adjacent to the existing pedestrian crosswalk, there exists a BART vent shaft structure. This condition requires two modifications to the street in order to provide an outbound island at Eighth Street. First, the westbound trackage must be moved approximately 9 inches to the north to ensure a 5 foot distance between center line of track and the edge of the island curb. Secondly, a 3 to 3-1/2 foot widening of the existing 50 foot curb line is required to accommodate a 6 foot island and 11 foot travel lane adjacent to the BART entrance. Without a streetcar extension which provides islands at Eighth, this major intrusion can be averted.

West of Eighth Street, Market Street is 68 feet wide. The streetcar tracks from Eighth to Van Ness Avenue must be replaced for revenue service. West of Eighth Street there is a need for three traffic lanes in each direction. To accommodate traffic lanes and also provide streetcar islands any new trackage installed west of Eighth Street must weave. At Van Ness Avenue, no westbound island is proposed. Should streetcars be extended to Van Ness, the passenger loading stop would be accommodated on northbound Van Ness Avenue. The loading platform would be provided by bulbing the existing east sidewalk north of Market Street.

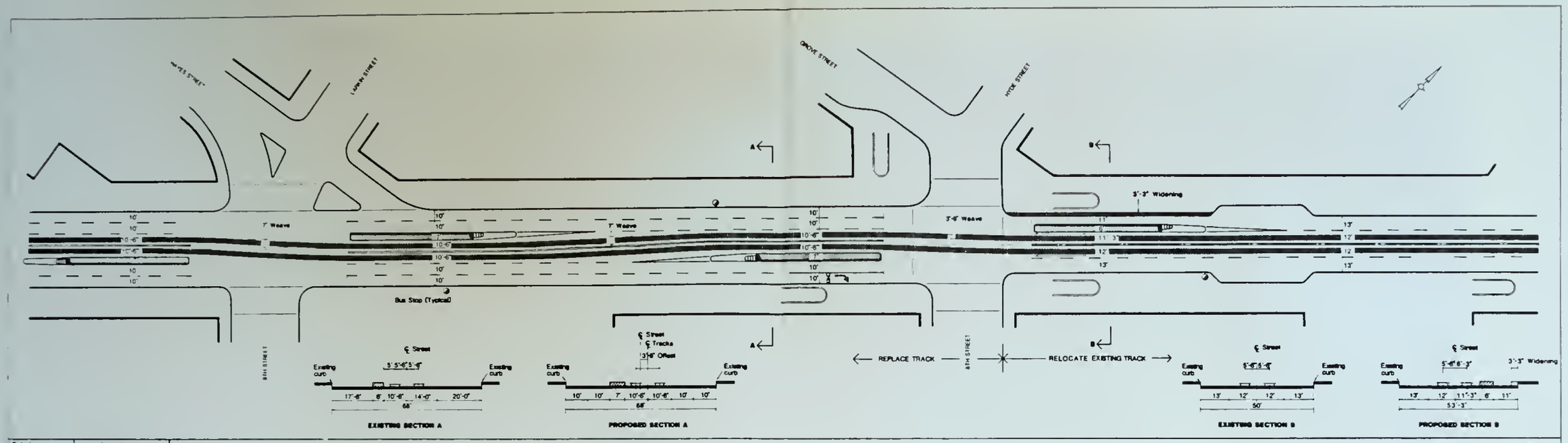

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FIGURE V-6
PROPOSED ALTERNATIVE A & C
EIGHTH TO NINTH

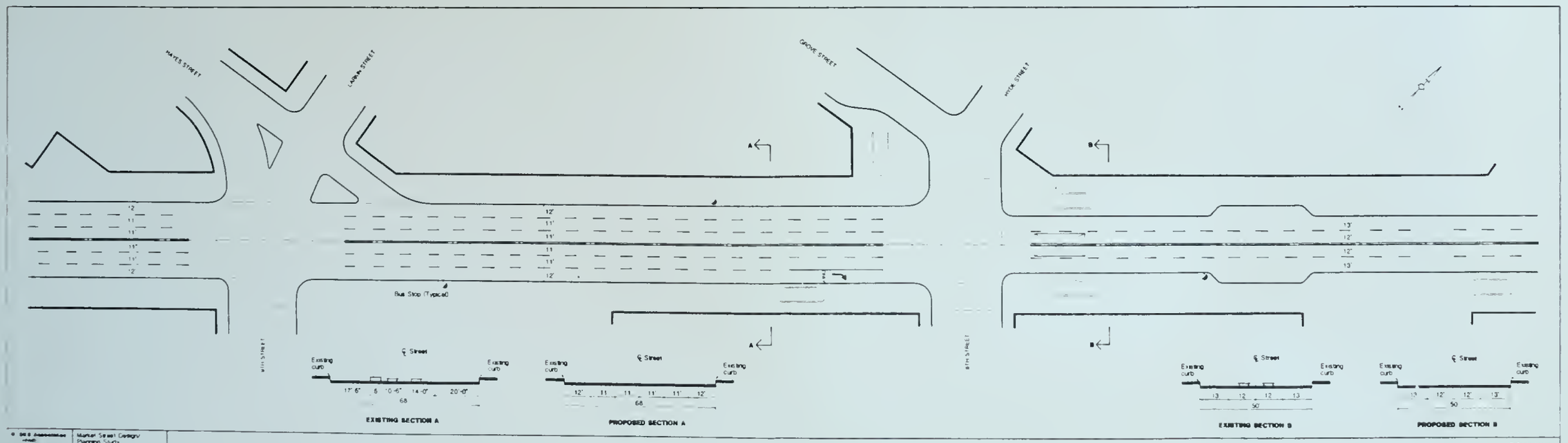

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FIGURE V-7
PROPOSED ALTERNATIVE B
EIGHTH TO NINTH

Implications of the Alternatives

An evaluation of Market Street from Fremont to Van Ness Avenue was conducted for each alternative. The implications of the plans relative to existing conditions on the street were analyzed. The advantages and disadvantages of each alternative were developed. The following sections describe these evaluations.

Figures V-8 and V-9 delineate the various elements which are found within the sidewalk areas of Market Street. Reference to these elements is made below when they need to be removed, relocated or modified.

Alternative A (with streetcars--weave all track)

From an overall street configuration point of view, this alternative is the most attractive if streetcars are to remain on Market Street. The major advantages to this option are:

- Requires little or no widening of the street relative to the original street beautification design.
- Minimizes relocation of any equipment now located in the sidewalk area.
- Does not impede pedestrian flow around any BART entrances.
- Does not interefere with any utility or service located in sidewalk.
- Allows sufficient room to meet City's stated minimum requirements for loading island width and traffic lane widths.
- Does not require signal relocation due to conflict with overhead wire.

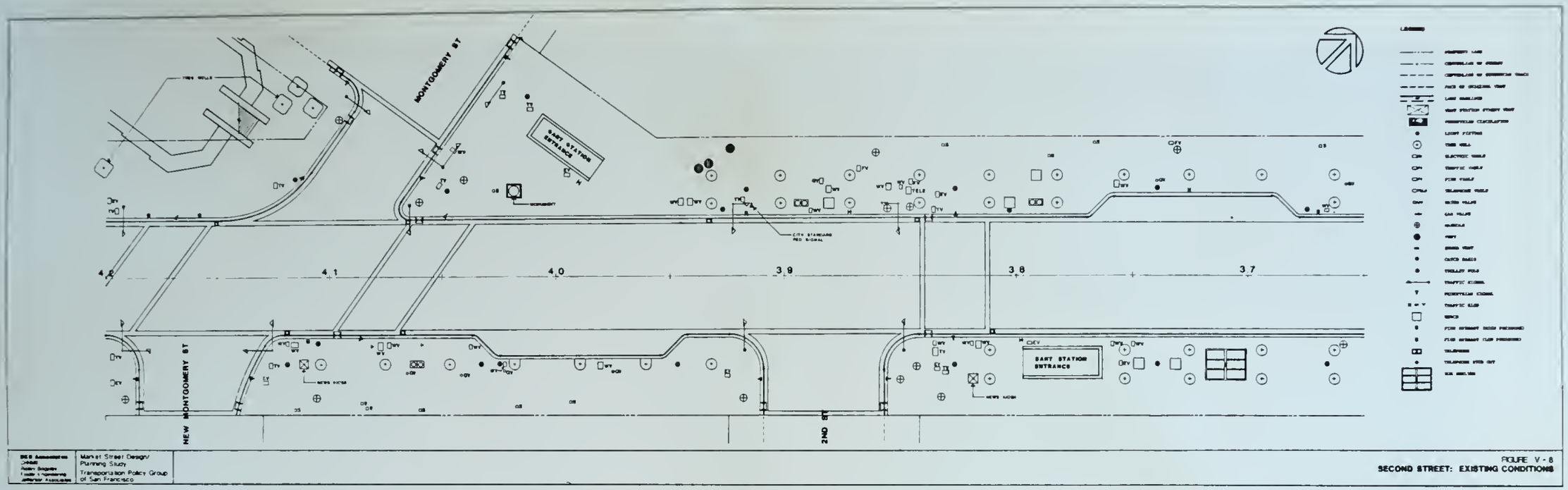

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FIGURE V - 8
SECOND STREET: EXISTING CONDITIONS

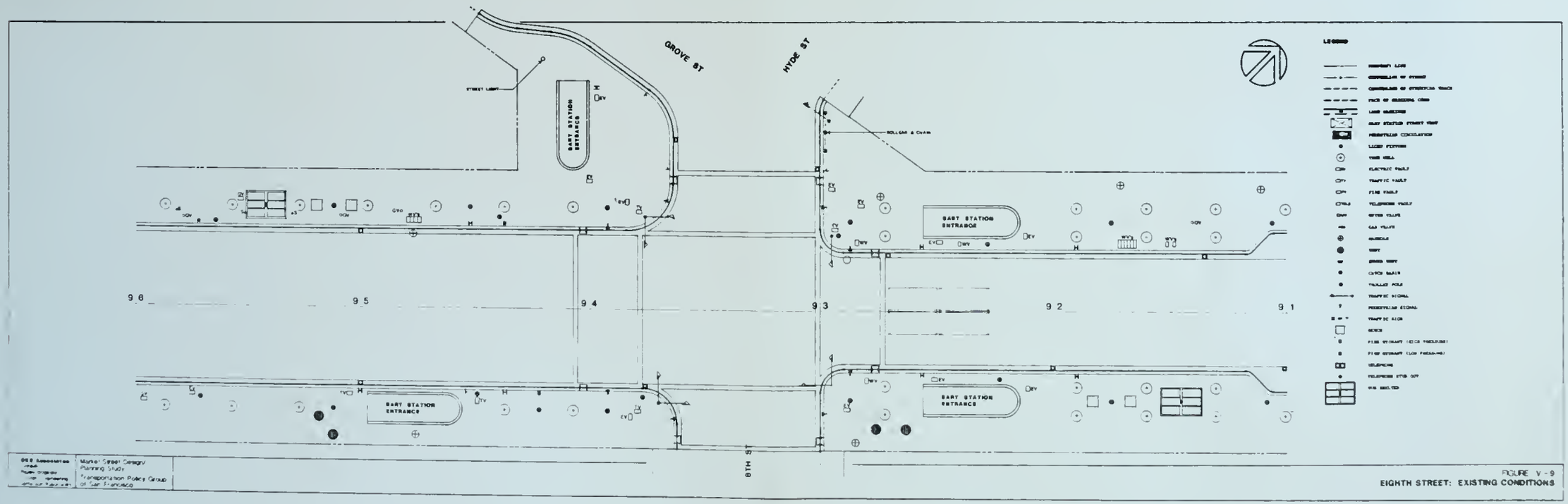

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FIGURE V - 9
EIGHTH STREET: EXISTING CONDITIONS

Some disadvantages to this option are:

- Requires moving some otherwise good track (approximately 8400 feet) and repaving otherwise good sections of street.

- Requires new supports over BART vent shafts where track is relocated for weaving.

- Extends track into street area now occupied by utilities to the possible detriment of both track and utilities.

Alterntive B (without streetcars--weave lanes)

From an overall street configuration and cost point of view, this alternative is the most attractive:

- Requires little or no widening of the street relative to the original street beautification design.

- Minimizes the relocation of any equipment now located in the sidewalk area.

- Does not impede pedestrian flow around any BART entrances.

- Does not interefere with any utility or service located in sidewalk.

- Allows sufficient room to meet City's stated minimum requirements for loading island width and traffic lane widths.

- Minimizes potential conflict between trolley bus poles and existing signal arms.

- Has none of the disadvantages of Alternative A. Weaving transit lanes over utilities are of no consequence since all streetcar track is removed.

Alternative C (with streetcars--keep good track--weave new track)

From a cost point of view this is an attractive alternative. From a street/sidewalk configuration view point, it is unattractive.

- Eliminates cost of relocating 8400 feet of good track. This represents 47 percent of the streetcar track on Market Street between Fremont and Van Ness).
- Retain good sections of pavement near tracks.
- Requires substantial intrusion into present sidewalk areas.
- Requires relocation of signal poles where street is widened.
- Poses possible utility conflicts in area where track weaves.
- Negates necessity and cost of moving tracks over BART vent shafts.
- Travel lanes between curb and island are only 11 feet wide.

Modifications to Existing Street to Accommodate Proposed Alternatives

Sidewalk/Curb Area: Alternatives A and B

To achieve proposed 51 foot wide vehicle way the following modifications are proposed in those areas that presently have temporary curbs.

- Install 12 inch wide granite curb in lieu of 18 inch wide design curb.[1]

---

[1] The original Market Street reconstruction project utilized an 18 inch curb and a 24 inch gutter.

- Install a 12 inch wide solid granite gutter. The reduced gutter dimension and solid construction should reduce breakup problems currently experienced. (See Technical Appendix). However, for urban design continuity, maintaining a constant granite gutter line may be desirable. This would require a 30 inch solid granite gutter at significantly greater cost.

- Extend catch basin (6 inches) to edge of curb.

- Rebuild sub-base as needed to adequately support finish materials under heavy vehicle loading.

- Relocate pedestrian signals and traffic signs.

Alternative C

To achieve adequate street width for passenger loading islands, the following modifications are proposed.

- Widen street adjacent to loading islands 2 foot, 3 inches.

- Relocate all pedestrian signals and traffic signs.

- Relocate fire hydrants adjacent to passenger loading islands.

- Move catch basin adjacent to islands and extend catch basins for 51 foot street.

- Use 12 inch granite curb and 12 inch solid granite gutter.

- Cut into sidewalk for new foundations, electrical conduits, piping, etc.

- Pull new conductors, install valves, extend high pressure water and other utility lines.

- Cut paving and install new meter boxes, shut off valve boxes, etc.

- Install and extend or modify all line or other connections to meters and boxes.

- Relocate any other affected utility lines.

- Rebuild, as required, any vault spaces affected by increased street loading, manhole relocations, etc.

- Rebuild affected subslab.

- Replace and patch brick paving, including border soldier courses.

- Remove and relocate curb returns and gutters at cross streets, patch affected crosswalks.

- Remove affected trees and grating. Cap off utilities, patch subslab, patch-in new brick paving.

- Completely rebuild, to sidewalk design, removed service bays, as required.

Street area/widening: Alternative A

To achieve adequate curb lane width at loading islands, the following modifications are proposed.

- Remove all bad streetcar track.

- Remove good streetcar track in areas of track weaving.
- Replace good track, as required, in all of the above areas.
- Regrade street to new elevations in track areas.
- Repave regraded street areas.
- Repave all other areas affected by track relocation.
- Move and/or reconstruct manholes or other subgrade facilities affected by island placement and construction.

Alternative B

- Remove all streetcar track.
- Regrade area of streetcar tracks to new elevations.
- Remove all areas affected by track removal and/or street regrading.
- Move and/or reconstruct manholes or other subgrade facilities affected by island placement and construction.

Alternative C

To achieve an adequate curb lane width at loading islands, the following modifications are proposed.

- See Sidewalk/Curb Area above.
- Rebuild any vault roofs and relocate manhole, as necessary, resulting from street widening.

- Install adequate roadway sub-base and pave new street areas.
- Remove all bad streetcar tracks.
- Regrade and rebuild street in area of bad streetcar tracks (all other areas already regraded to new, permanent elevations).
- Repave regraded areas.
- Move and/or reconstruct manholes or other subgrade facilities affected by island placement and construction.

Islands (for all alternatives)

- Remove all existing islands.
- Construct new islands including curbs, paving and handicapped ramps.
- Construct curb lane barrier.
- Construct auto barrier at approach end (where appropriate) and install impact attenuator.
- Install special warning pavement, striping and buttons in front of islands.
- Install break-away sign.
- See "street area widening" for subgrade requirements.

OPERATIONAL ELEMENTS

The allocation of bus routes between curb and island, the location of transit stops and

signal timing were operational elements analyzed under each alternative. Route allocations remain the same with or without streetcars; however, stop locations and signal timing must be modified depending on the status of streetcar operation.

Route Allocation

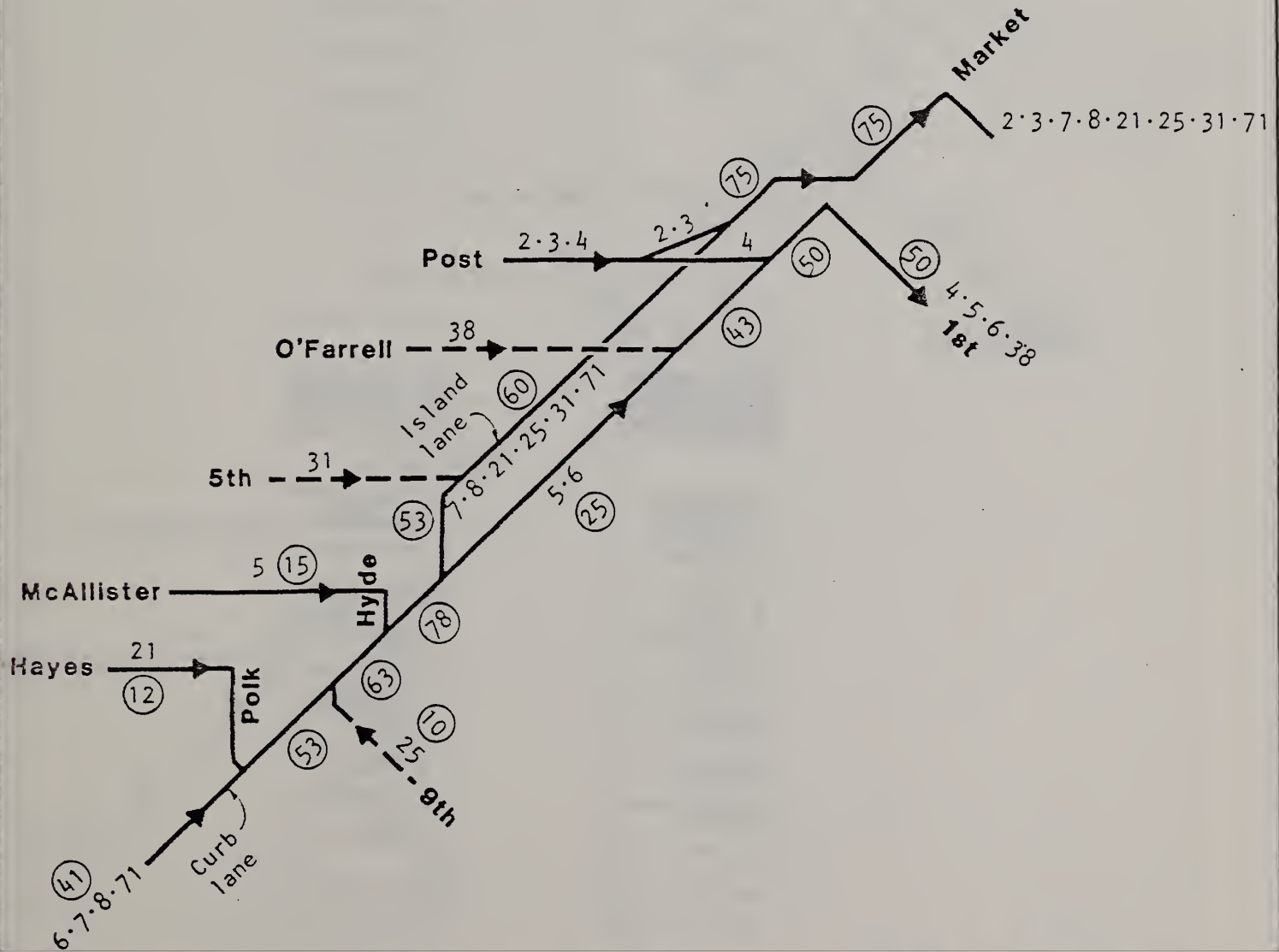
Separation of routes between curb and island stops must be consistent and logical. Route allocation should group lines of common destination to reduce passenger confusion, minimize crossing of buses from island to curb for turning and balance the number of buses which use either island or curb stops. In the eastbound direction, routes destined for the Transbay Terminal were separated from lines destined for the Embarcadero (Figure V-10).

By operating in the curb lane, Transbay routes would be able to turn right at First Street without crossing lines destined for the Embarcadero. Also, appropriate bus stop signing should be developed along Market Street which indicates bus stop location and route destinations under curb and island operation (Figure V-11).

The outbound routes were grouped by lines which operated on Market Street beyond Eighth Street and those which turn off Market Street (Figure V-12). This effectively eliminates any weaving of bus routes. The 6, 7, 8 and 71 lines operate to outer Market Street and were grouped together on the islands. In addition, the 21 and 25 lines, which turn off Market Street at Eighth and Eleventh Streets, were also placed on the islands. All routes which turn off Market Street between Sutter and McAllister Streets were grouped together at curb bus stops, including Routes 2, 3, 4, 5 and 38. Bus stop signing for outbound routes would be extremely important to minimize passenger confusion. Figure V-11 recommends a potential sign format for outbound curb and island bus stops.

Stop Locations

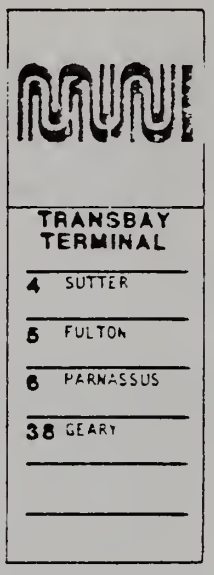
Using the criteria established in Chapter IV, bus stop locations were selected along Market Street from Steuart Street to Van Ness Avenue (Figures V-13, V-14 and V-15). Typically, where physical constraints would permit, the island and curb bus stops were

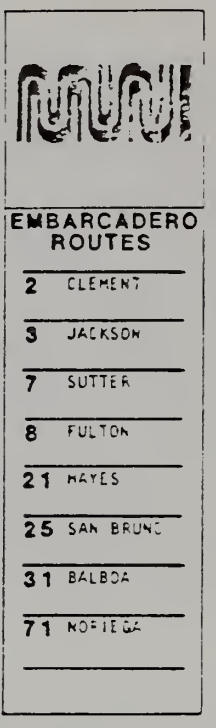


[1] Scenario IV developed by MUNI Planning Staff.

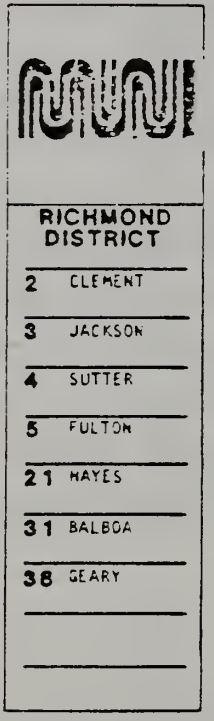
● DKS Associates ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 10 **PROPOSED TRANSIT ROUTE ALLOCATIONS: EASTBOUND**[1]

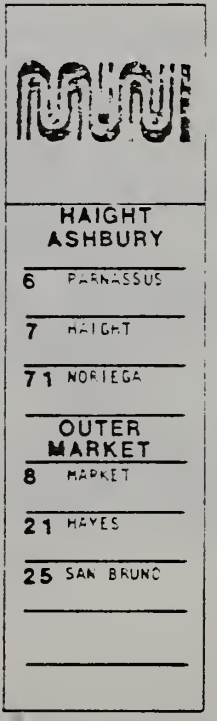
INBOUND



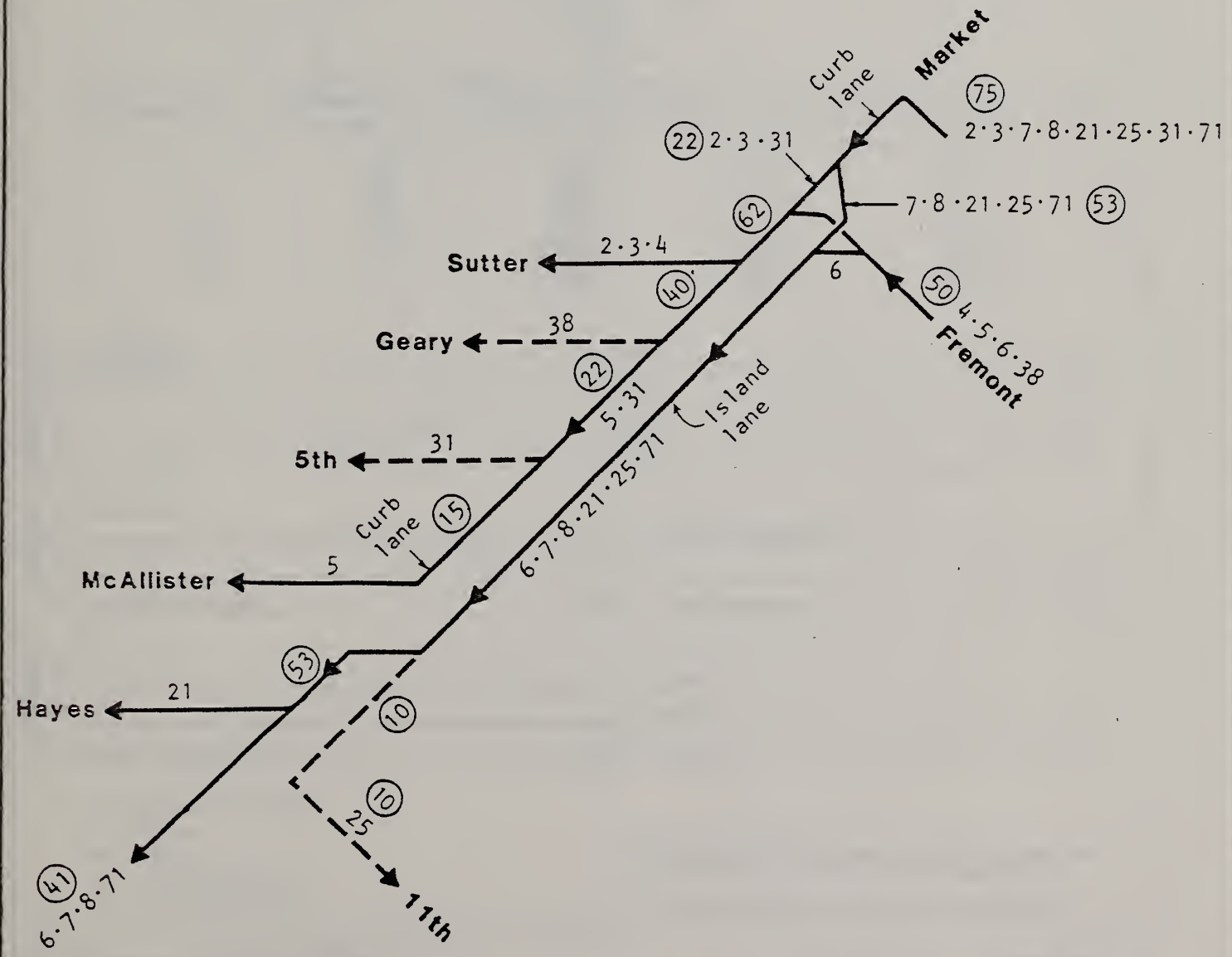


OUTBOUND



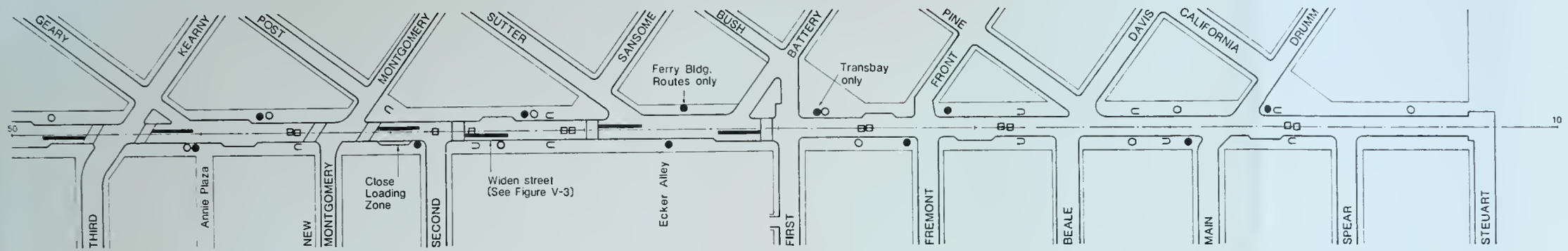


● **DKS Associates** ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 11 **PROPOSED BUS STOP SIGNS**



[1] Scenario IV developed by MUNI Planning Staff.

● DKS Associates ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 12 **PROPOSED TRANSIT ROUTE ALLOCATIONS: WESTBOUND** [1]



STREET WIDTH*

EXISTING	52'-6"					50'	
ALTERNATIVE A	51'	54'-9"		51'		50'	
B	51'	54'-9"		51'		50'	
C	51'	54'**	51'	54'**	54'-9"	54'**	51'	50'

TRACKS

ALTERNATIVE A	New track (Weave)		No track (depending on route alternative)
B	No track		
C	New track (Weave)	Keep existing track	New track (Weave)	No track (depending on route alternative)

PAVEMENT

ALTERNATIVE A	Reconstruct pavement		Existing to remain
B	Reconstruct pavement		Existing to remain
C	Reconstruct pavement	Existing to remain	Reconstruct pavement	Existing to remain

- ● Proposed Bus Stops
- ○ Shelters
- ▬ Islands
- □ BART/MUNI Vents
- ⊂ BART/MUNI Entrances

* Street width is the basic section width and does not account for right turn lanes or truck loading bays

** Widen street adjacent to passenger loading islands

DKS Associates
CH2M Hill
Ripley Bocatay
Foster Engineering
Jefferson Associates

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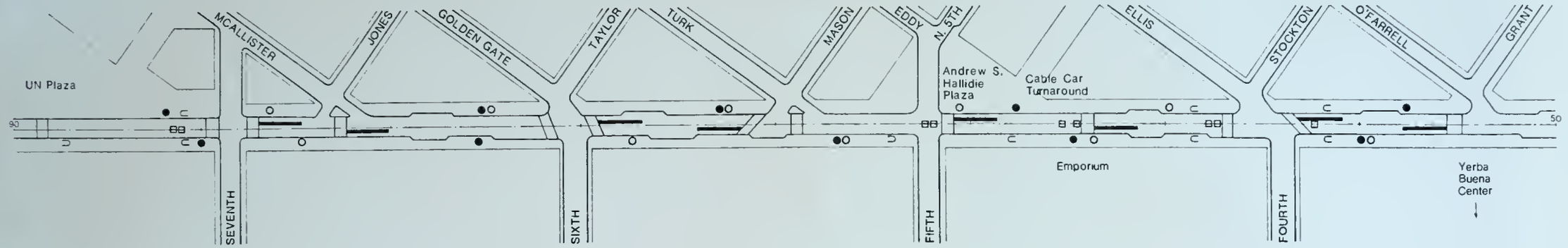
FIGURE V-13
PROPOSED TRANSIT STOPS
EMBARCADERO TO THIRD



STREET WIDTH*

EXISTING	50'	52'-6"					
ALTERNATIVE A	50'	51'					
B	50'	51'					
C	50'	51'	54'**	51'	54'**	51'	

TRACKS

ALTERNATIVE A	Keep existing tracks	New tracks (Weave)		
B	No tracks			
C	Keep existing tracks	New tracks (Weave)	Keep existing tracks	New tracks (Weave)

PAVEMENT

ALTERNATIVE A	Existing to remain	Reconstruct pavement		
B	Existing to remain	Reconstruct pavement		
C	Existing to remain	Reconstruct pavement	Existing to remain	Reconstruct pavement

- ● Proposed Bus Stops
- O Shelters
- ▬ Islands
- □ BART/MUNI Vents
- ⊂ BART/MUNI Entrances

* Street width is the basic section width and does not account for right turn lanes or truck loading bays

** Widen street adjacent to passenger loading islands

● DKS Associates
○ CHS/AB
○ Ridley Bocatay
○ Foster Engineering
○ Jefferson Associates

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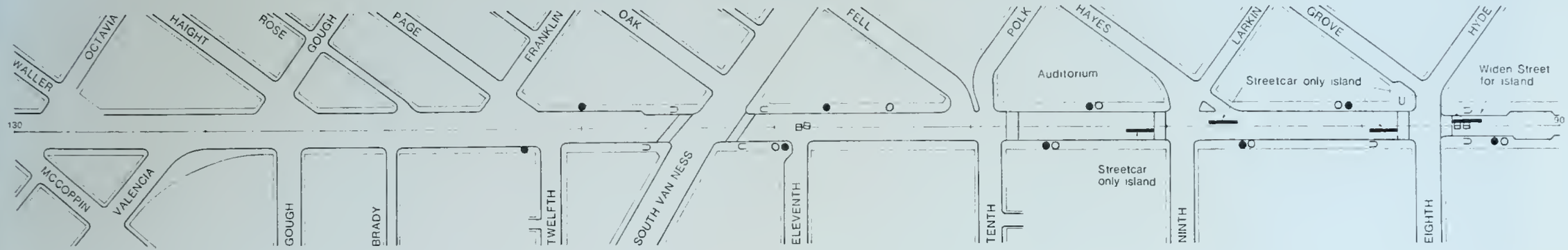
FIGURE V-14
PROPOSED TRANSIT STOPS
THIRD TO UNITED NATIONS PLAZA



STREET WIDTH*

EXISTING	68'	50'	
ALTERNATIVE A	68'	50'**	50'
B	68'	50'	
C	68'	50'**	50'

TRACKS

ALTERNATIVE A	New track**	Keep existing track
B	No track	
C	New track**	Keep existing track

PAVEMENT

ALTERNATIVE A	Existing to remain
B	Existing to remain
C	Existing to remain

PROJECT BOUNDARY

- ● Proposed Bus Stops
- O Shelters
- ▬ Islands
- D BART/MUNI Vents
- C BART/MUNI Entrances

* Street width is the basic section width and does not account for right turn lanes or truck loading bays

** Depending on route alternative selected.
Note: Islands may be necessary requiring 53'-3" street width at Eighth Street

DKS Associates
CHS Consultants
Pickey Bogatay
Foster Engineering
Jefferson Associates

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FIGURE V-15
PROPOSED TRANSIT STOPS
UNITED NATIONS PLAZA TO VAN NESS

located in a staggered configuration (a near side island trailed by a curbside bus stop). In many cases, the existing curb and island bus stops were maintained. However, changes have been recommended at some locations which are discussed below.

First/Fremont. In the eastbound direction, a curbside bus stop was added adjacent to Ecker Alley. With a nearside island stop, a staggered island/curb configuration was achieved. Westbound, a new curb stop was placed nearside of First Street for outbound Transbay Terminal routes only. The nearside curb stop at Sutter/Sansome would be for outbound curb-stopping lines from the Ferry Building. The first curb stop for both Transbay and Ferry Building routes would be the far side Sutter/Sansome stop between Sutter and Second Street. This configuration was selected to reduce bus concentrations which are heaviest between Fremont and Sutter Streets during the peak hour.

In addition, Transbay buses typically stop at First Street for a red signal indication upon entering Market Street. With the new nearside curb stop for Transbay routes at First, signal delay and passenger loading dwell can be combined to reduce overall delays.

With this operational plan, the 2, 3 and 4 routes cannot be served on Market Street (westbound) by a single stop location. The first stop where all three routes stop together would be on Sutter Street, west of Sansome Street. Also, the first stop away from Transbay Terminal (westbound) for the 6 line would be the Sutter/Sansome island. As an alternative to this plan, an island could be placed on Fremont Street, nearside of Market (discussed later in this chapter).

Montgomery/Second. The westbound stop locations were maintained; however, the eastbound stop placements changed. The eastbound island stop was moved to the far side of Second Street to: (1) avoid traffic concentrations and BART vent/escalator conflicts approaching New Montgomery Street; (2) to eliminate side-by-side eastbound/westbound islands which require extensive widening; and (3) to provide adequate maneuvering space for the 2, 3 and 4 lines which enter Market Street eastbound from Post Street. By placing the island stop far side of Second Street, conflicts with BART/MUNI Metro vent shafts and escalators must be addressed. This conflict is acceptable only because placement of the island stops at other nearby locations is less desirable.

The eastbound curb stop would be moved from far side of Second Street (away from the proposed island) to near side Second Street. To accommodate curbside bus loading, a truck loading bay (65 feet) must be closed. In addition, to provide adequate length for the proposed westbound passenger island the west crosswalk of Market at Second Street would be removed (as proposed in the Market Street Reconstruction and Beautification Project). The evening peak hour pedestrian flow is only moderate (660) and two nearby adjacent crosswalks exist at Second (east 65 feet) and Montgomery (west 125 feet).

Fourth/Fifth. Placement of the eastbound island stop was dictated by Powell Station vent shaft locations. To avoid BART/MUNI Metro vent shafts, the Powell Street crosswalk was moved approximately 100 feet east to accommodate the proposed island placement (See Figure V-14). The Powell pedestrian signal would be centered between Fourth and Fifth Streets with the crosswalk directly in front of Emporium/Capwells main entryway. The island stop would be located on the far side of the crosswalk with the curb stop placed near side. Essentially, the existing eastbound island would be shifted 100 feet to the east, the curb stop would be moved 100 feet to the west and the small near side loading island at Fourth Street would be removed. Island and curb stops are placed in staggered fashion westbound at the near side of Fourth and Fifth Streets. The existing island near Powell Street and the curb bus stops at near side Fifth Street, far side Stockton Street and mid-block Geary/O'Farrell would be removed. Together with stops at Third Street and Sixth Street, westbound stops would be placed in a staggered configuration (island followed by curb bus stop) at approximately 900 to 1,000 foot intervals.

Seventh/McAllister. A near side island would be placed westbound at Seventh Street with a far side curb stop (Figure V-14). This provides for potential transfers at Seventh, from curb or island, to Golden Gate Transit or Greyhound and achieves better stop spacing. The eastbound island is shifted 200 feet east, away from far side Seventh Street to far side of McAllister/Jones, to avoid side-by-side islands. Better traffic delineation approaching the island can be developed at this location, reducing accident potential. Should McAllister Street become two-way for transit, placement of the eastbound island would be shifted eastward to near side Sixth Street (discussed later in this chapter).

West of Seventh Street. The placement and type (curb/island) of bus stops west of Seventh Street is dependent upon providing or not providing streetcar service on Market Street. Without streetcars, all bus passenger loading would occur curbside. Peak hour bus volumes on Market Street beyond McAllister Street are not large enough to warrant parallel bus operation. Island only stops west of Seventh Street (without streetcars) would add to reconstruction costs, reduce passenger convenience and access, while increasing passenger exposure to accidents. Curb stops would not add cost to reconstruction of Market Street, would utilize existing bus shelters, minimize passenger exposure to potential vehicle conflicts, and enable use of wide sidewalk space for passengers waiting and alighting.

Market Street presently reserves the two center streetcar track lanes for transit only, even though weekday routes utilize the curb lane. Since only four lanes (two in each direction) are presently available for traffic, island stops can achieve a slight operational advantage to curb stops. Narrow lane geometrics at Van Ness restrict auto and bus traffic causing some backups and delay to transit. (The westbound roadway width between island and curb is so narrow that it typically operates as a single lane). Comparing weekday streetcar (island stops) and bus (curb stops) running times between Seventh Street and Van Ness Avenue indicates a maximum 14 second savings using islands versus curb stops. With proposed changes in Market Street utilization, six lanes (three in each direction) would be available to transit and vehicular traffic, adding capacity and wider lanes thereby making the transit operational time difference between curb and island stops insignificant.

With streetcar operation, some passenger loading islands would have to be provided. Figure V-15 indicates potential Market Street passenger island locations, depending on the route selection near Civic Center (discussed in Chapter VI).

With streetcars, all trolley and diesel coach operation west of Seventh Street would remain on the curb. Curb operation would be maintained for the same reasons stated above. In addition, it is necessary for bus operation to be consistent between alternatives since the overhead wire rehabilitation will be completed prior to final Market Street design. Therefore, any additional loading islands west of Seventh Street

could be designed to accommodate only streetcars. A smaller island (approximately 6 feet by 70 feet) would be appropriate to serve ten minute streetcar headways.

Signal Timing

The most effective means of improving transit operations and reduce stopped-bus delays is to establish signal progression favoring transit. The two largest components of bus stopped time are (passenger loading/unloading) dwell and signal delay. The coordination of signals for transit is most effective when typical passenger loading and unloading activities occur during a red signal, allowing the bus to proceed through an intersection on the following green signal without additional delay.

Setting signals to favor bus flows improves transit operation by reducing signal delay and minimizing the attractiveness of Market Street to through vehicle traffic. With signal progression, buses approach near side intersection stops during a green phase allowing traffic to clear the stop on red. Buses approach unobstructed stops permitting transit boarding and alighting activities to occur during the red phase without additional delays.

Time-space signal diagrams were developed using existing travel data for bus operation (average speed and passenger dwells were computed from data presented in Technical Appendix). The proposed signal system was developed to provide flexibility in bus operating characteristics. Passenger loading times are quite variable, especially near the financial district and Hallidie Plaza. Signals were set such that should passenger dwell time exceed average conditions by one standard deviation at any stop, a bus could proceed through the adjacent intersection without signal delay. In addition, signals were set to allow buses to enter into the Market Street system with minimal delay (for example, Routes 5, 21, 31 and 38).

The 60 second cycle length was selected to coordinate with signal systems north and south of Market Street. This allows the potential for interconnection of signals on streets which cross Market. Signal splits were developed using existing settings and capacity analysis of existing flow conditions. Table V-1 summarizes the splits and

offsets of a signal system which provides signal progression for inbound bus volumes during the morning peak and outbound bus volumes during the evening peak.

To install this progression system would only require adjusting existing signals. All signals have three settings capability for AM, PM and off-peak conditions. However, condition of the interconnect cable is not known and some repair may be necessary.

The proposed theoretical signal system operation was compared to the existing bus flow conditions (Table V-2). A 22 percent decrease in travel time could be achieved in the peak direction during both AM and PM peaks without increasing off peak direction travel time. To maximize the effectiveness of the proposed signal system in reducing transit travel times, splits and offset should be adjusted after the first year, then every three to five years. Transit travel time and delay information should be collected to evaluate the need for signal setting adjustments.

The proposed signal system was developed assuming a historic streetcar with operational characteristics similar to trolley and diesel coaches, such as a President's Conference Committee (PCC) streetcar. MUNI presently owns two vintage heavyweight streetcars for potential use on the E and F-lines and has recently leased a third car for similar use.

These vintage units and other old streetcars have lower performance characteristics than trolley and motor coaches or PCC cars. Acceleration and deceleration are lower and some older cars have limited speeds. Accordingly, there is some potential for operational conflict between buses and streetcars on Market Street. However, at the present time it is assumed that the number of low-performance cars would be few, or that they would be operated only during off-peak periods so as to minimize interference with bus and trolley coach operations. Should vintage streetcars be utlized on Market Street, the proposed signal system would be difficult to effectively implement due to to varying operational characterisitcs of transit vehicles using the center lane.

DESIGN ELEMENTS

Several design elements were analyzed along Market Street, including street width, island design, shelter design, overhead wire poles, crosswalk/curb and gutter design,

Table V-1
PROPOSED SIGNAL SETTINGS

Intersection	AM Peak Offset	AM Peak Split	PM Peak Offset	PM Peak Split
Main/Drumm	45	40/60	0*	40/60
Beale/Davis	75	50/50	30	50/50
Fremont/Front	55	50/50	10	50/50
First/Battery	80	38/17/45	55	38/17/45
Sansome/Sutter	0	60/40	40	60/40
Second	35	70/30	35	70/30
New Montgomery	5	45/55	60	45/55
Third/Kearny	30	50/50	75	50/50
Grant/O'Farrell	55	65/35	30	65/35
Fourth/Stockton	95	50/50	40	50/50
Powell	25	65/35	70	65/35
Fifth	75	50/50	80	50/50
Mason/Turk	20	55/45	15	50/50
Sixth	55	55/45	0	55/45
Jones/McAllister	65	60/40	80	60/40
Seventh	35	55/45	55	50/50
UN Plaza	80	70/30	10	70/30
Eighth	50	50/50	85	45/55
Ninth	50	55/45	50	45/55
Tenth	50	50/50	25	50/50
Van Ness	0 *	50/50	15	40/60

* Reference street for offsets.

Table V-2
TRAVEL TIMES*

	Existing** (No Progression)	Proposed (With Progression)
AM Peak Period		
Peak Direction (Eastbound)	16.0 minutes	12.5 minutes
Off-Peak Direction (Westbound)	13.2 minutes	13.0 minutes
PM Peak Period		
Peak Direction (Westbound)	18.3 minutes	14.2 minutes
Off-Peak Direction (Eastbound)	16.5 minutes	14.3 minutes

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* Drumm/Main to Van Ness.

** Average of 7, 8, and 21 lines.

pavement reconstruction, construction materials and truck loading zones. Many of these elements are discussed below and differences between design with and without streetcars are noted.

Street Width

With the proposed lane widths recommended in Chapter IV, Market Street would be 51 feet curb-to-curb between Fremont Street and Seventh Street under Alternatives A and B. This represents a street width one foot wider than proposed in the Market Street Reconstruction and Beautification Project. The additional 12 inches provides sufficient travel lane widths adjacent to passenger loading islands. To accommodate the wider street dimension, a 12 inch granite curb would be installed in lieu of the 18 inch granite curbs provided east of Fremont Street and west of Seventh Street.

For Alternative C, the street would be widened three feet to accommodate passenger islands in areas where existing track is maintained. The basic street width between Fremont Street and Seventh Street would be 51 feet, except where loading islands occur. Figure V-1 summarizes the proposed street cross sections for Alternatives A, B and C.

East of Fremont Street and between Seventh and Eighth Streets, Market Street has been built to its final 50 foot cross section. In these areas, the existing street would not be widened except to provide a streetcar island (if necessary) at the near side of Eighth Street, eastbound. Dimensions would need to be adjusted (narrowed) to accommodate curb travel lanes and passenger loading islands within a 50 foot street section.

With or without streetcars, the center travel lanes and streetcar tracks would weave to provide space for passenger loading islands. Weaving travel lanes presents some safety concerns; however, the weaving distance from beginning (stop line) to end (across far side crosswalk) is typically 110 feet (assumes 50 foot cross street and two 30 foot crosswalks)

which provides suitable length for taper.[1] The curb travel lanes would never weave in Alternatives A or B, but would be offset three feet for Alternative C due to widening.

With a 51 foot street section, the relationship between pedestrian signals, traffic signs and fire hydrants to the edge of curb would be changed. All of the sidewalk elements were placed along Market Street assuming a 50 foot street section. Pedestrian signals and traffic signs were centered 30-3/4 inches from the proposed edge of an 18 inch granite curb. This has not been adequate to avoid damage from parked vehicles or buses. With a 12 inch curb, pedestrian signal heads and signs would be even more vulnerable. To reduce potential damage from moving traffic with the proposed 51 foot street width, pedestrian signals and traffic signs should have at least a two foot clearance from the closest point on the sign or signal head to the curb face.

The standard set back for fire hydrants (center to edge of curb) is 27 inches in San Francisco.[2] With a 12 inch curb and a 51 foot street width, hydrants along Market Street would generally be within this standard. However, under Alternative C, street widening would require relocation of fire hydrants adjacent to loading islands.

Island Design

The basic issues of passenger loading island design discussed in Chapter IV were used to evaluate the proposed island design. Figures V-16 and V-17 show the recommended near side and far side passenger loading islands for Market Street. The major elements of the island design include:

- lane striping to split traffic preceding island (typically 105 feet where feasible);

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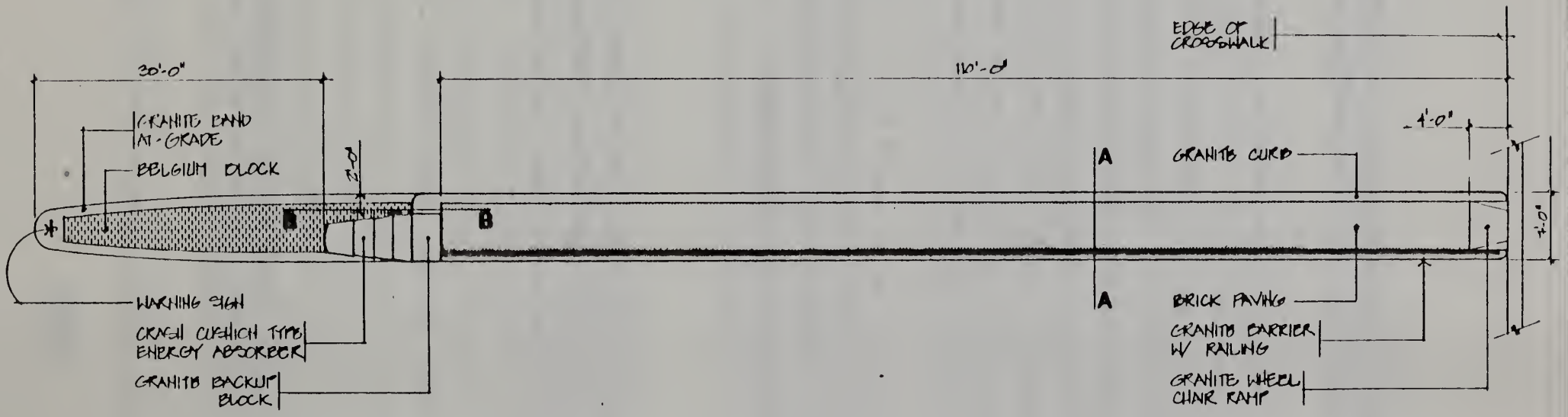
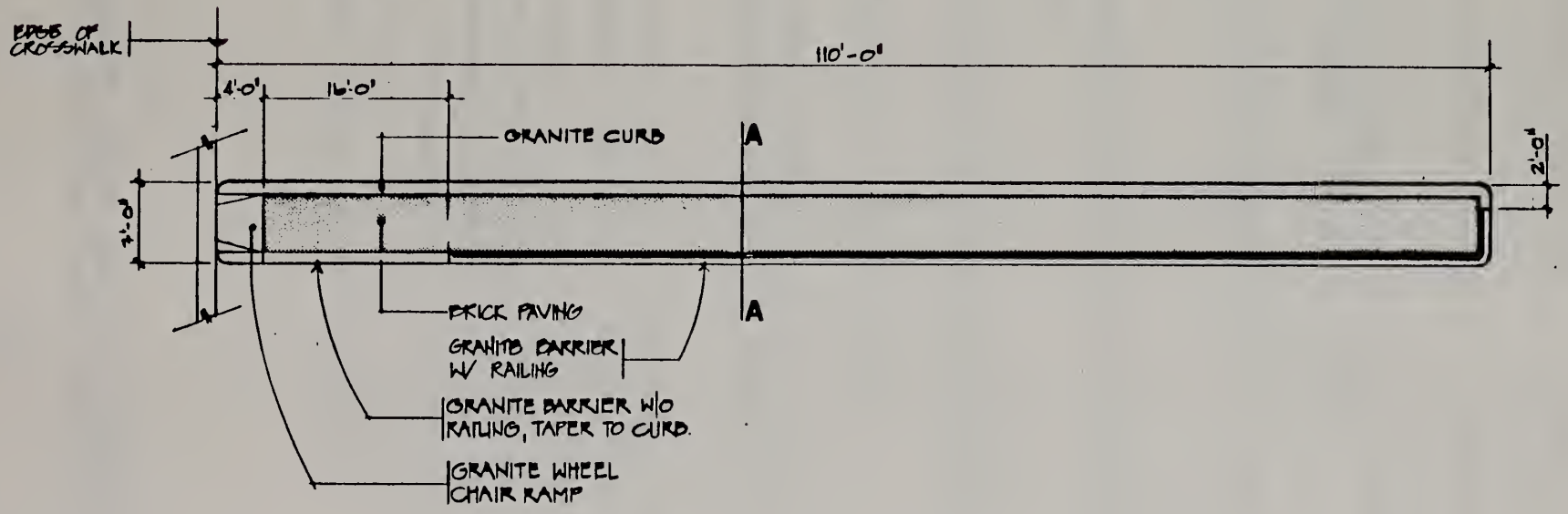
1 "Traffic Manual", State of California, Department of Transportation, July 1981, pg. 6-25. The required length to transition a seven foot offset, assuming 30 mile per hour vehicle speeds, would be 105 feet which is less than the available 110 feet.

2 Bureau of Engineering, Department of Public Works, re: Mr. Vijay Gupta.



○ **DKS Associates** ● CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 16 **"NEAR SIDE" TRANSIT LOADING ISLAND**



○ **DKS Associates** ● CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 17 **"FAR SIDE" TRANSIT LOADING ISLAND**

- driver alerting pavement texture, where possible;
- breakaway traffic splitting signs, where possible;
- island barrier adjacent to curb lane to provide some impact diversion and protect passengers from moving traffic;
- vehicle barrier and impact attenuation device at approach-end of near side islands;
- sloping barrier at approach-end of far side islands to lessen severity of impact for autos;
- bus stop signing which indicate routes served by the island (see Figure V-11);
- handicapped ramp at crosswalk end; and
- island paving, barriers, curbs and details consistent with Market Street Beautification design, including use of granite, brick and bronze materials.

The island barrier design would be similar to a jersey barrier[1] on the traffic side and would allow passengers a wall to lean against for convenience on the island side (Figure V-18). To protect the island, barrier, passengers and drivers from possible collisions, an energy absorbing attenuator would be provided on near side islands (Figure V-18). The attenuator was designed to absorb impacts assuming vehicle speeds up to 40 miles per hour. With proposed lane striping, driver alerting pavement textures and signing, it is hoped that the crash cushion would not be utilized except for the rare occasions when a driver loses control of his/her vehicle.

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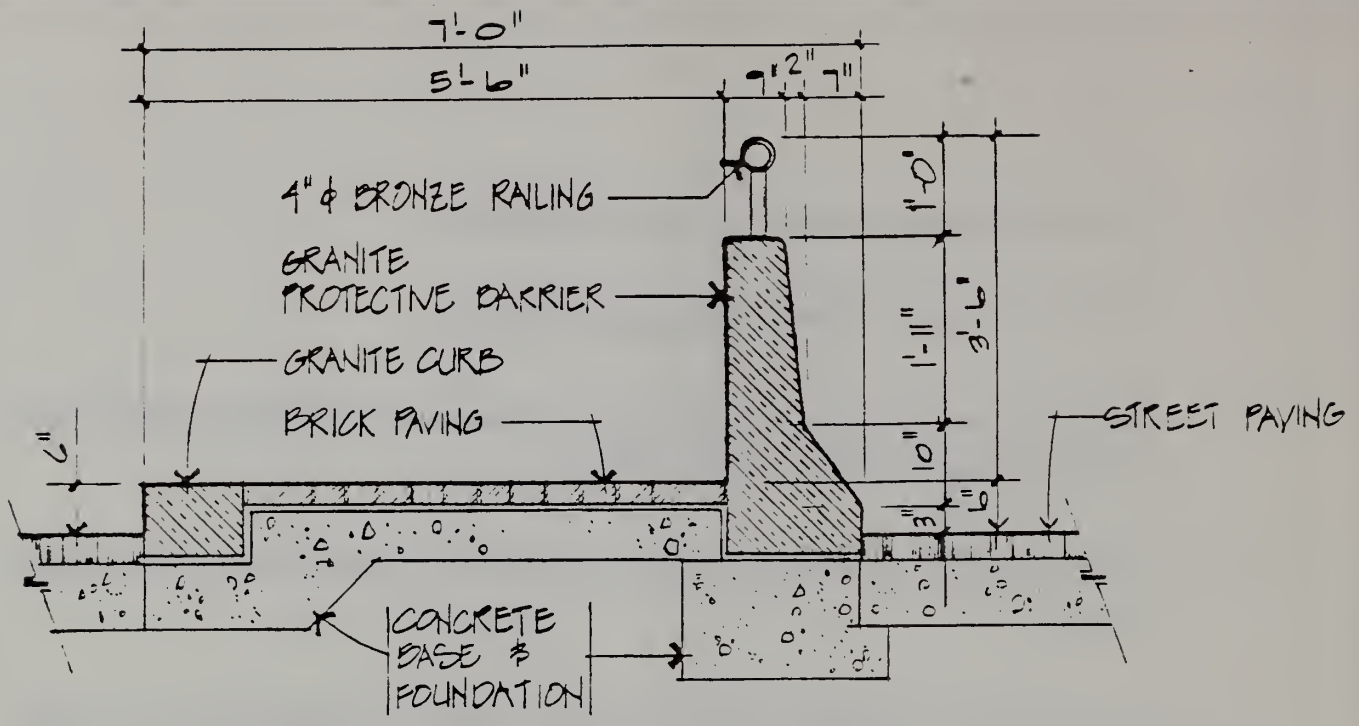
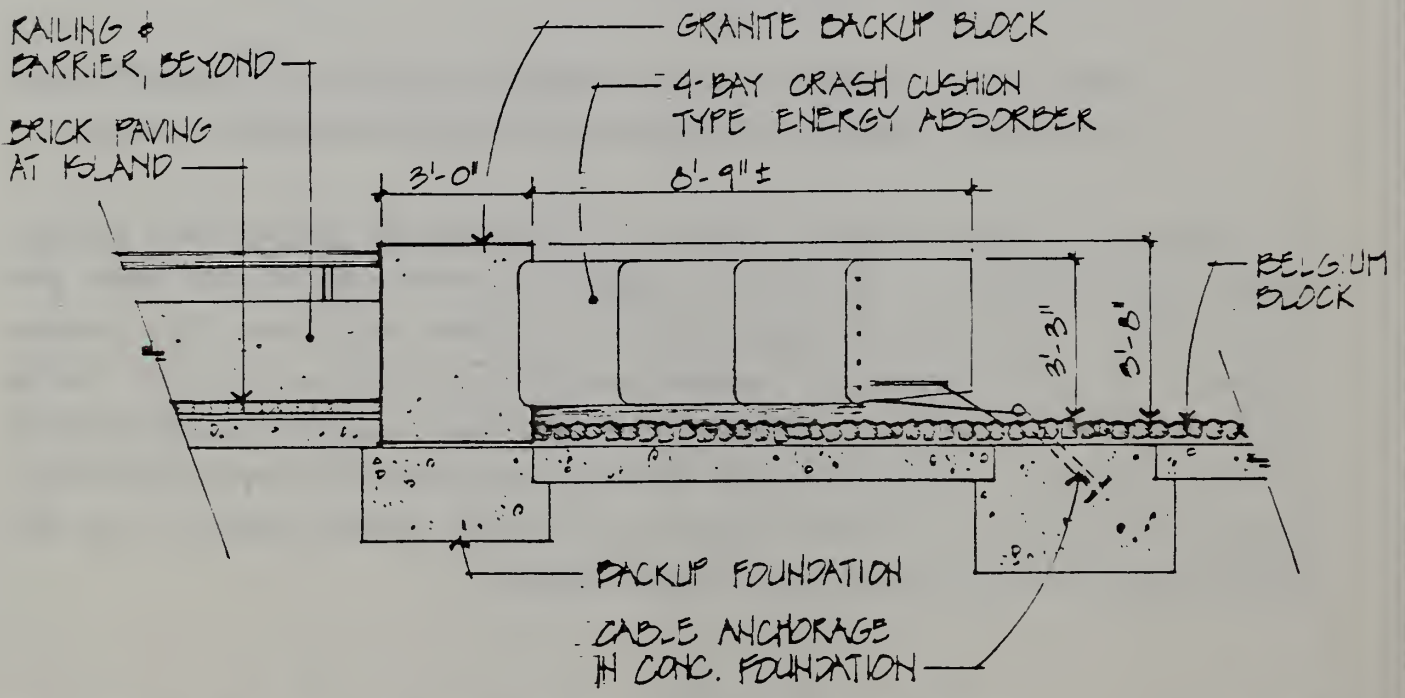
1 Similar to Concrete barrier type 25. "Standard Plans", State of California, Department of Transportation, January 1981, B11-53 and B11-30.



SECTION THRU ISLAND 1/2" : 1'- 0" A·A



ENERGY ABSORBER 1/4" : 1'- 0" B·B

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Bus Shelter Design

The existing shelters were designed as part of the original Market Street Beautification effort intermixed between rows of street trees. Present shelters are tree-like structures with a central post supporting a large roof. Currently, there are 27 shelters between Steuart Street and Van Ness Avenue.

The principal drawback of the existing shelters is their lack of weather protection. The combination of tall buildings along with San Francisco's often windy climate, sometimes make Market Street a cold and windy place, especially when waiting for a bus. During the winter, rain rarely falls straight down due to swirling winds making matters worse.

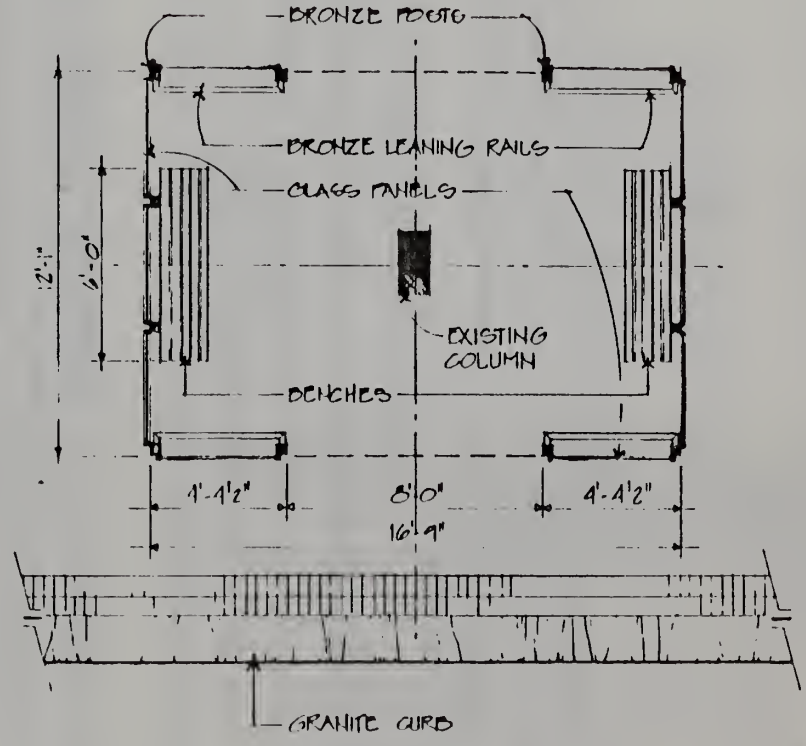
Design modifications have been proposed for the Market Street shelters to alleviate some of these problems by enclosing the existing shelters (Figure V-19). Weather protection would be increased by the addition of vertical clear partitions on the ends of the shelter, wrapping partially around the front. This would afford protection to anyone waiting in the shelter from wind and rain being blown from a number of directions. Partitions would be glass to allow visibility of approaching buses and to ensure security to waiting transit passengers. The posts which support the glass enclosure would be bronze to match the existing shelter materials.

Seating and leaning rails would be provided inside the shelter for transit patron comfort. Two six-foot benches would be provided on either end of the shelter and bronze leaning rails attached adjacent to the glass areas. Glass panel bottoms would be raised off the sidewalk 4 inches to facilitate sidewalk washing and avoid any accumulation of trash within the shelter enclosure. The costs associated with modifying bus shelters would be approximately $20,000 per shelter.

Some existing bus stops do not coincide with placement of shelters. Out of 27 shelters, only 19 are in the vicinity of current bus stops. In locating proposed stops for each alternative plan, the major criterion was to establish good transit operations, regardless of shelter locations. Even so, 18 proposed stops coincide with existing bus shelter placements. In locations where bus stops and shelters match, enclosures should be

END ELEVATION

SIDE ELEVATION



PLAN

○ **DKS Associates** ● CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 19 **BUS SHELTER MODIFICATIONS**

constructed with informational signing to integrate shelters into transit operations. The nine shelters which would not have bus stops should not be modified in order not to emphasize their use by transit patrons.

Potential relocation of existing shelters and/or construction of new shelters may not be feasible due to foundation conflicts with utilities, sidewalk vaults, and sub-basements. In addition, placement of new bus shelters may not visually coincide with existing themes established by the present street.

Overhead Wire Poles

Design criteria for poles was developed in Chapter IV; however, placement and final design is the subject of a parallel study currently under way (Market Street Guideway Project: Rehabilitation of Trolley Overhead). This study will not assess costs of rebuilding the overhead wire system. However, the cost of installing overhead wire poles would be $7,500 per pole.

Crosswalks/Curb and Gutter Design

In completing reconstruction of Market Street, a significant amount of crosswalk/curb and gutter work is necessary. Criteria established in Chapter IV should be observed in design of Market Street crosswalks, curbs and gutters. Sections of Market Street which have finished crosswalks and gutters have experienced damage in heavily used areas, for example at the intersections of Van Ness Avenue and Market Street, Hyde and Market Streets, and at bus stop locations on Market Street between Eighth Street and Van Ness Avenue.

It is estimated that approximately 530 square feet of brick crosswalks and granite gutters have been damaged out of a total of 81,000 square feet since 1975.[1] Therefore, proposed performance testing of crosswalk and gutter pavers by the Bureau of Engineering and the Bureau of Street Repair should be completed and alternatives presented in the Technical Appendix should be evaluated prior to actual reconstruction to ensure that adequate durability can be achieved.

Curbs. Twelve inch granite curbs would replace the current 3-3/4 inch concrete temporary curbs along Market Street between Fremont Street and Seventh Street. Presently, 18 inch granite curbs are used east of Fremont Street and west of Seventh Street. For the most part, these curbs would not be modified.[2]

By reducing the proposed curb size from the original standard of 18 inches, a slight design revision is necessary to ensure flow of surface water into existing catch basins. The current catch basin placement assumed an 18 inch curb would eventually be built. With a 12 inch curb, the catch basins should be extended 6 inches to the edge of curb. For Alternative C, catch basins would be relocated where ever street widening occurs.

Gutters. A 12 inch solid granite gutter should be used to eliminate potential break up problems. The current gutter consists of four rows of granite paving blocks. Most of the current breakup problems have occurred in the outer two brick rows.

Sidewalk Handicap Ramps. Present handicap ramps (both temporary asphalt and finished granite) protrude into the travel lanes of the street. Buses frequently run over the protrusions which jostle the vehicle and increases wear to adjacent granite gutters. Additionally, the protruding ramps impede drainage of surface water and collect debris. Where new handicap ramps are provided, they should be recessed into the sidewalk, when feasible, to eliminate protrusions.

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1 "Status Report Market Street Reconstruction and Beautification Project," Department of Public Works, Bureau of Engineering, July 1980.

2 Only where a westbound streetcar loading island is provided at near side Eighth Street would any curb changes occur.

Pavement Reconstruction

Under Alternatives A and B the Market Street pavement surface between Fremont Street and Seventh Street would be reconstructed except over BART stations. With Alternative C, pavement adjacent to good streetcar tracks would not require reconstruction. Excessive cross slopes would be eliminated and a new regraded street, with or without track, would be constructed. The street cross slopes should typically be a fifth of an inch per foot.

Granite Centerline Delineator. The present granite center strip in place east of Fremont Street would not be used west of Fremont. Instead, standard delineation with double yellow stripes should be utilized.

Construction Materials

The materials used for loading islands and other Market Street construction elements should be consistent with the existing Market Street Beautification Project (granite, brick, bronze, glass and procelain enamel on steel). With limited availability of funds, use of alternative construction materials may be pursued to reduce cost. However, the original materials were selected by the City and County of San Francisco through the Transit Task Force for their appearance and durability. Use of other materials should be consistent with original criteria to avoid degrading the present design and investment.

Alternative Materials: A number of alternative materials were suggested during this study. These are evaluated below:

- Concrete is the only material that could substitute for granite and represent any significant cost difference. Concrete should be sandblasted or have a similar finish to improve its initial appearance and minimize maintenance (graffiti removal) procedures. Concrete curb and gutters would not need special finishing and are much less expensive than granite; however, concrete was not used in the Market Street Beautification Project.

- Brick is presently utilized to define all pedestrian paths (crosswalks and sidewalks). Utilization of other materials for crosswalks would not match existing sidewalks.

- Any metal material as maintenance free as bronze, such as stainless steel, is just as expensive. Steel must be galvanized and painted for protection and appearance. Although cost is initially less, to maintain suitable appearance, continuing long term maintenance costs would be necessary. Steel with baked on, or epoxy enamel finish is another option. It has a lower initial cost than bronze and involves less maintenance than painted steel.

- "Core-ten" steel is maintenance free but tends to stain its surroundings (especially concrete) and would be inappropriate in both use and appearance on Market Street.

- Use of plexi-glass as a substitute for glass would be unacceptable since plexi-glass clouds with age reducing visibility and is difficult to maintain (graffiti and poster removal).

Truck Loading Zones

The proposed plan locates stops away from truck loading areas. However, the loading zone west of Second Street along the south curb would be removed to accommodate a new curbside bus stop. Curb bus stop placement in other locations would be less desirable. Provision to close this bay and extend sidewalk paving would cost about $14,000.

The basic truck loading zone design remains unchanged under Alternatives A and B; however, with Alternative C, street widening to accommodate passenger loading islands would require adjacent loading zones to be closed or widened (encroaching into the sidewalk up 2 feet, 3 inches). Loading zones would be affected by Alternative C island placement at; eastbound: Third, Powell, Mason/Turk, and McAllister; westbound: Fourth and Sixth.

With two-lane parallel transit operation on Market Street, truck double parking must be eliminated for effective transit operation. Double parked trucks close the curb lane leaving only one effective lane for transit and auto traffic. Without auto infringement or improper commercial vehicle use of truck loading bay, adequate truck parking would be available. Increased enforcement of truck loading zones would reduce illegal usage. Vehicles illegally using truck loading space or exceeding the 30 minute maximum duration should be ticketed. Better parking enforcement should improve compliance, providing space for legitimate truck activity, while generating additional revenue (in excess of cost) through ticketing.

TWO-WAY MCALLISTER STREET

The potential of making McAllister Street two-way between Market Street and Hyde Street has been discussed in previous studies;[1] however, no detailed analysis has been performed to substantiate any modification. With the proposed Market Street transit operational plan, it would become highly desirable to allow the 5 Fulton line to enter and exit Market at McAllister.

Parallel curb and island transit service would end at Seventh Street westbound and begin at McAllister Street inbound with the proposed plan. In the outbound direction, parallel transit service would continue until the 5 line exits Market Street at McAllister Street. However, the inbound 5 line turns onto Market Street at Hyde Street, a block and a half prior to parallel transit service. The difference between the 5 line's entry and exit point to Market Street conflicts with additional transit carrying capacity created by parallel operation. The 5 Fulton would operate either 15 standard coaches or up to 12 articulated coaches during future peak service hours. Since all eastbound lanes would operate on the curb between Eighth Street and Seventh Street (5, 6, 7, 8, 21, 25 and 71 lines), this

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1 San Francisco Municipal Railway, "San Francisco Muni Transportation Planning, Operations, Marketing Study", October 1976, pages 138 and 140; and

San Francisco Municipal Railway, "Five Year Plan: 1980-1985", April 1980, page 180.

segment of Market Street would constrain possible future service expansions. Therefore, it would be highly desirable to coordinate 5 line operation with parallel transit service on Market Street.

By allowing 5 Fulton to operate two-way on McAllister Street, the possible transit service constraint would be eliminated. Between 13 to 17 percent additional curb lane bus capacity would be available from Eighth to Seventh Street (eastbound) since parallel transit service on Market Street would be coordinated with the entry and exit of the 5 line. To effectively accommodate two-way operation of McAllister Street, modifications to existing Market Street channelization and proposed island placement are necessary (see Figure V-20). Removal of on-street parking would be necessary on McAllister between Market and Leavenworth. The cost of the proposed modifications at Market Street would be $125,000 (costs were not developed west of Market).

Two-way McAllister Street would also improve 5 line operating characteristics. By surveying travel times for the 5 line between Market Street and Hyde Street, the time savings between outbound (straight McAllister), compared to inbound (via Hyde/Market) was quantified (see Technical Appendix for survey data). Inbound running times (excluding stopped time) were 40 seconds longer than outbound running times representing a 36 percent time savings between Hyde and Market using McAllister.

In addition, eliminating inbound turns at Hyde and Market Streets helps:

- make the route more understandable, easier to remember for passengers;
- simplify route for drivers;
- improve rider comfort;
- remove a major source of potential accidents; and
- improve reliability.[1]

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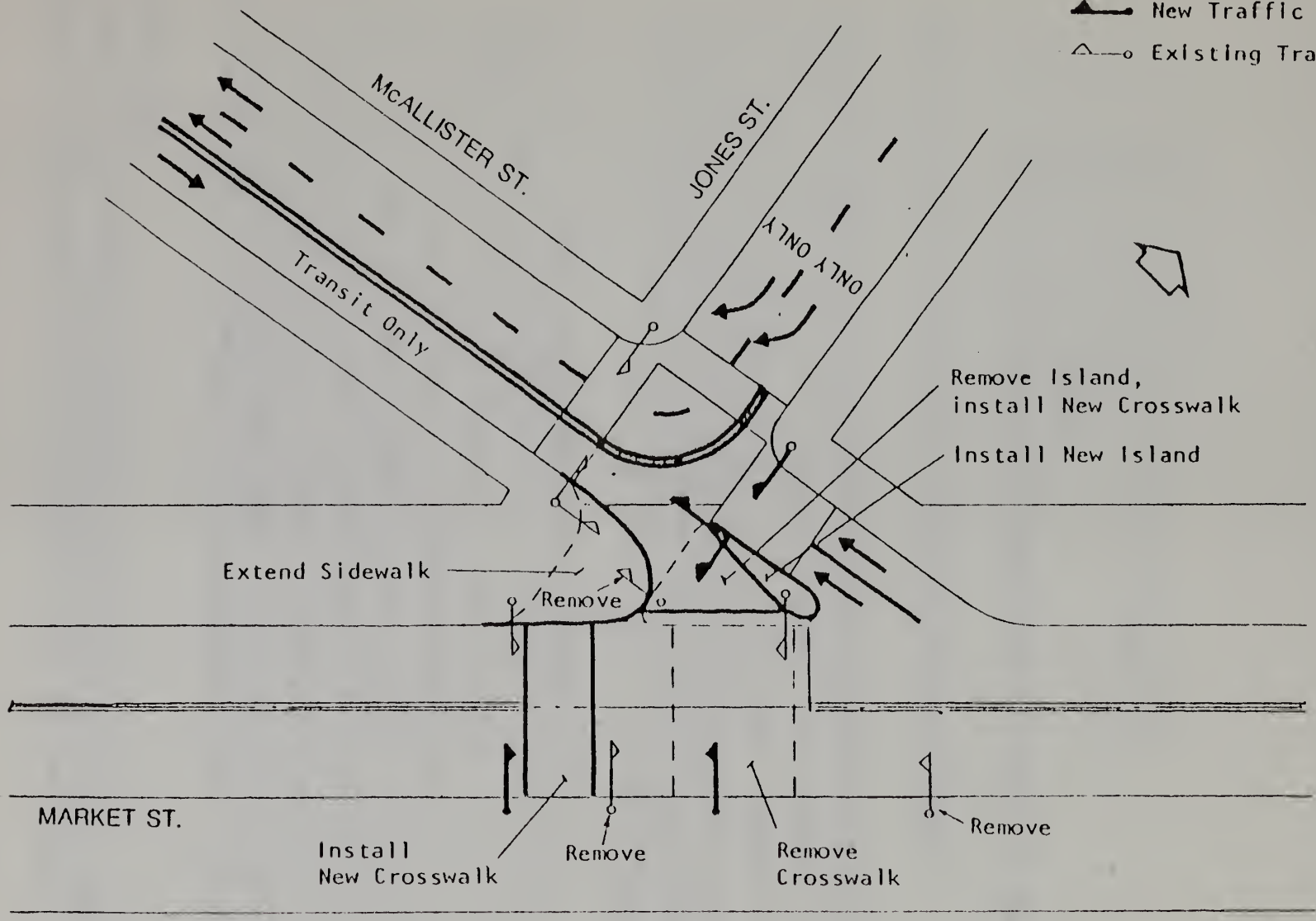
[1] San Francisco Municipal Railway, "San Francisco Muni Transportation Planning, Operations, Marketing", October 1976.



● DKS Associates ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 20 **McALLISTER STREET MODIFICATIONS**

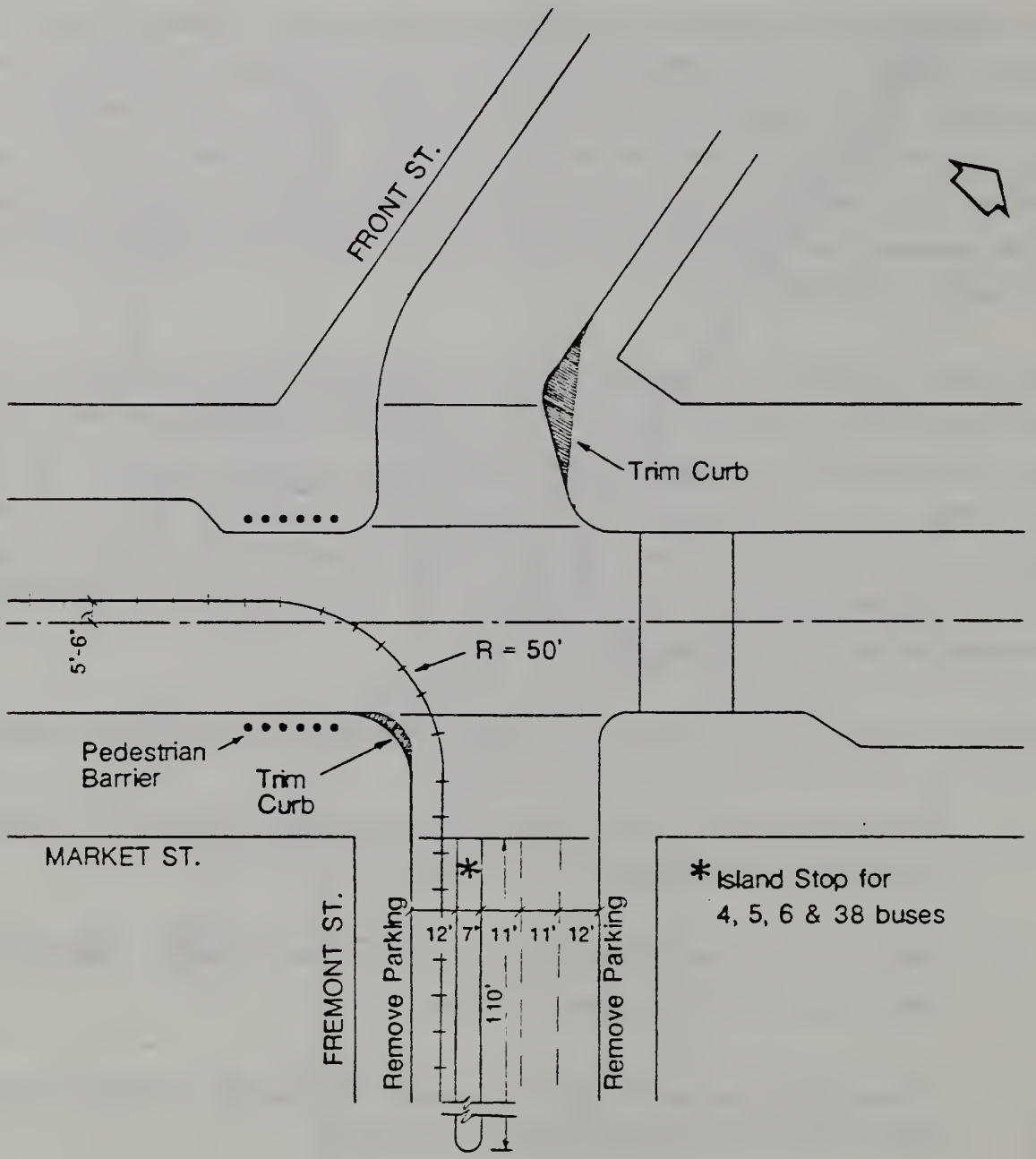
FREMONT STREET ISLAND

As an alternative to the proposed westbound operational plan between Fremont Street and Sutter Street, an island stop could be provided for Transbay Terminal routes on Fremont, near side of Market Street (Figure V-21). The existing width of Fremont Street would allow three travel lanes, an island and a left turn "transit only" lane to be developed. With streetcar operation to and from Transbay Terminal, special trackwork would be necessary to accommodate curbside operation including a 50 foot turning radii from Fremont to Market.

Operationally, all outbound Transbay Terminal routes would stop at the Fremont island before entering Market Street. Most routes would experience some signal delay at First Street upon entering the proposed Market Street signal progression system. Outbound Market Street routes originating from the Ferry Building would continue to stop on the curb, near side of Fremont Street. Beyond Fremont Street all bus routes on Market Street would be separated into curb and island stops. The first stop on Market Street for all routes would be at Sutter/Sansome.

The primary differences and issues of a Fremont Street island are summarized below.

- The curb side stop at First Street on Market in the proposed plan is replaced by an island stop on Fremont for all Transbay routes.
- The 6 line has an intermediate stop between Transbay Terminal and Sutter/Sansome with the Fremont island.
- A Fremont island would allow a common stop for the 2, 3, and 4 lines on Market Street before exiting onto Sutter Street.
- Signal delay could potentially increase at First Street with a Fremont island compared to the proposed plan. Typically, a bus would encounter a delay of 10 seconds.



● DKS Associates ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE V - 21 **FREMONT STREET ISLAND**

- An additional island and special streetcar trackwork (if necessary) at Fremont and Market would increase overall costs.

- Streetcars may or may not use a Fremont loading island depending on the east end route alternative selected (Chapter VI).

- The proposed elimination of Embarcadero Freeway access north of Market Street would place an increased emphasis on vehicle demand crossing Market Street into the financial district (currently under study[1]). Provision of an island stop on Fremont Street would reduce the flexibility of serving additional traffic demand.

COST ESTIMATES

The following cost estimates relate directly to the three proposed Alternatives A, B and C. Streetcar track costs relate only to the section of Market Street from Fremont Street to 12th Street and include no costs for any trackage that might be proposed elsewhere either on or off Market Street. Costs related to underground utility work recognize extensive past experience while not overloading either the unit costs or the resulting totals. However, no recognition is made of any costs that may result from placing either streetcar tracks or loading islands over existing utility lines.

All costs are based upon completing the work consistent with the existing Market Street Beautification design. These estimates represent the upper cost range that might be expected due to the materials selected. Substitution of other materials for granite, brick and bronze, such as concrete or steel, would reduce the costs of elements that use those materials. In the case of loading islands, their overall cost might be reduced by as much as 50 percent, providing that aesthetic and possibly maintenance differences can be

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1 Proposals to eliminate the Embarcadero Freeway are currently being studied re: "I-280 Transfer Concept Program", State of California, Department of Transportation.

accepted. The cost savings for the islands would not represent a large percentage of the total project cost.

The costs for each alternative are summarized in Table V-3. The costs range from $16,500,000 to $23,500,000. The major differences betweeen the costs with the exception of general conditions and contingencies are in the categories of demolition, sidewalk modifications, and streetcar trackage. For comparison purposes, the cost to complete the original Market Street Reconstruction Project from Fremont to Van Ness Avenue would be approximately $11,500,000. Detailed unit costs and quantities are included in the Technical Appendix.

A brief description of the basic cost items follows:

- General conditions -- 20% of total construction cost

- Demolition -- removal of all required sidewalk elements, curbs/gutters, paving, streetcar tracks, etc.

- Traffic Control -- maintaining of traffic and circulation during construction.

- Sidewalk Modifications -- any required sidewalk modifications including removal and replacement of materials with the sidewalk areas. Materials include: curbs, brick, utilities, traffic and pedestrian signals, poles, etc.

- Streetcar Tracks -- installation, modification or removal of streetcar trackage.

- Street Element Relocation -- relocate or modify such street related elements as fire hydrants, catch basins, pedestrian signals, traffic signs, BART logo signs and closing a truck loading bay near Second Street.

Table V-3
PRELIMINARY COST ESTIMATES[1]
(1982 Dollars)

Item	Alternative A	Alternative B	Alternative C
- General Conditions	2,652,000	1,862,000	2,037,000
- Demolition	1,578,000	1,222,000	668,000
- Traffic Control	500,000	500,000	500,000
- Sidewalk Modification	61,000	59,000	285,000
- Streetcar Trackage	3,592,000	0	1,603,000
- Street Element Relocation	188,000	188,000	309,000
- Surfacing	4,408,000	4,408,000	3,901,000
- Loading Island	1,154,000	1,154,000	1,154,000
- Trolley Poles	1,458,000	1,458,000	1,458,000
- Bus Shelters	437,000	437,000	437,000
- Contingencies	1,603,000	1,129,000	1,235,000
Subtotal	17,631,000	12,417,000	13,587,000
Contractor Overhead/Profit	2,645,000	1,863,000	2,038,000
Design/Contract Administration	3,174,000	2,235,000	2,446,000
TOTAL	23,450,000	16,500,000	18,100,000

[1] Cost do not include:

- overhead wire rehabilitation;
- vehicle fleet requirements (coaches or streetcars);
- maintenance facilities; and
- streetcar route alternatives off Market Street in the vicinity of Civic Center and Transbay Terminal.

- Surfacing -- installation and modification of any plan element including curbs/gutters occurring between sidewalk areas in the street. Islands are not included.

- Loading Islands -- all costs to construct new islands on Market Street.

- Trolley Poles -- Constructing new 25 foot high, 12 inch diameter trolley poles to accommodate overhead wires from Steuart to 12th Street.

- Bus Shelters -- modification of all existing sidewalk bus shelters to ensure more rider protection.

- Contingencies -- 10 percent of construction costs.

- Contractor Overhead/Profit -- 15 percent of construction costs.

- Design/Contract Administration -- 18 percent of construction costs.

CHAPTER VI
STREETCAR ISSUES

With streetcar operation on Market Street there are several issues not previously discussed concerning route alternatives at the eastern and western ends of Market Street, streetcar maintenance and potential patronage. Each of these issues were analyzed and are discussed on the following sections.

STREETCAR ROUTE ALTERNATIVES: EAST END

Current MUNI service expansion proposals[1] establish the F-line streetcar which would serve Market Street and operate as a branch of the proposed E-line (Southern Pacific Depot to Fort Mason) along the Embarcadero. Present streetcar service on Market Street terminates at Transbay Terminal. To incorporate a connection of Market Street service to the Embarcadero and Fisherman's Wharf area requires an extension of the present track configuration. Four route alternatives were developed and analyzed as possible means of providing the Market Street to Embarcadero extension (Figures VI-1 and VI-2).

Common to all alternatives are the issues of vehicle layovers, vehicle storage and maintenance facility access. Initial investigation into the maintenance issue suggests for the long term, a permanent storage and maintenance facility should be developed in the south of Market area. A practical access to such a facility is via the Embarcadero. With the extension of the E-line along the Embarcadero, easy streetcar access could be provided. Vehicles would turn onto the southbound E-line trackage where streetcar operations interface with E-line service and proceed to the storage-maintenance yard.

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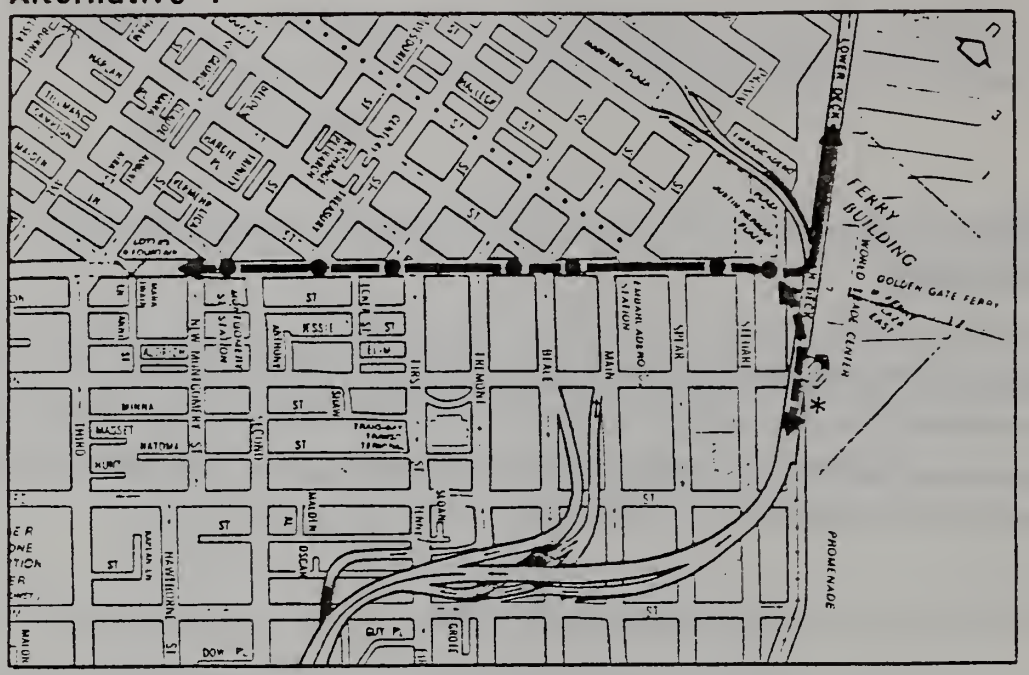
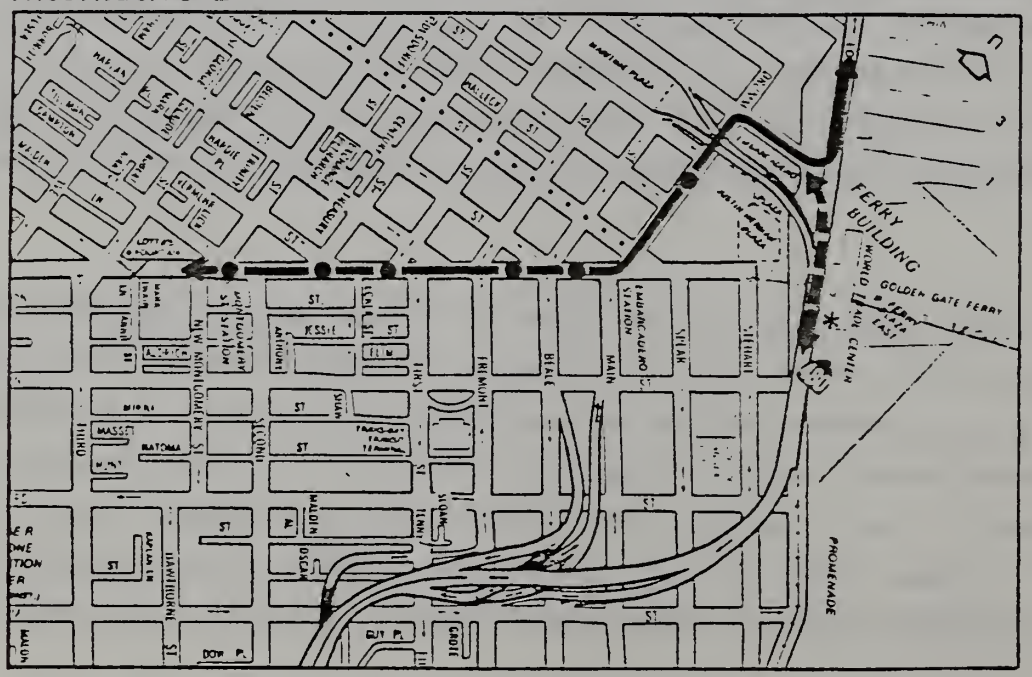
1 San Francisco Municipal Railway, "Five-Year Plan; 1982-1987, Volume 3, Final Draft," April 7, 1982, pg. 3-9.

Alternative 1



Alternative 2



● Passenger Stop
✱ Storage/Maintenance Access

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○ CHNMB
○ Ripley Bogatay
○ Foster Engineering
○ Jefferson Associates

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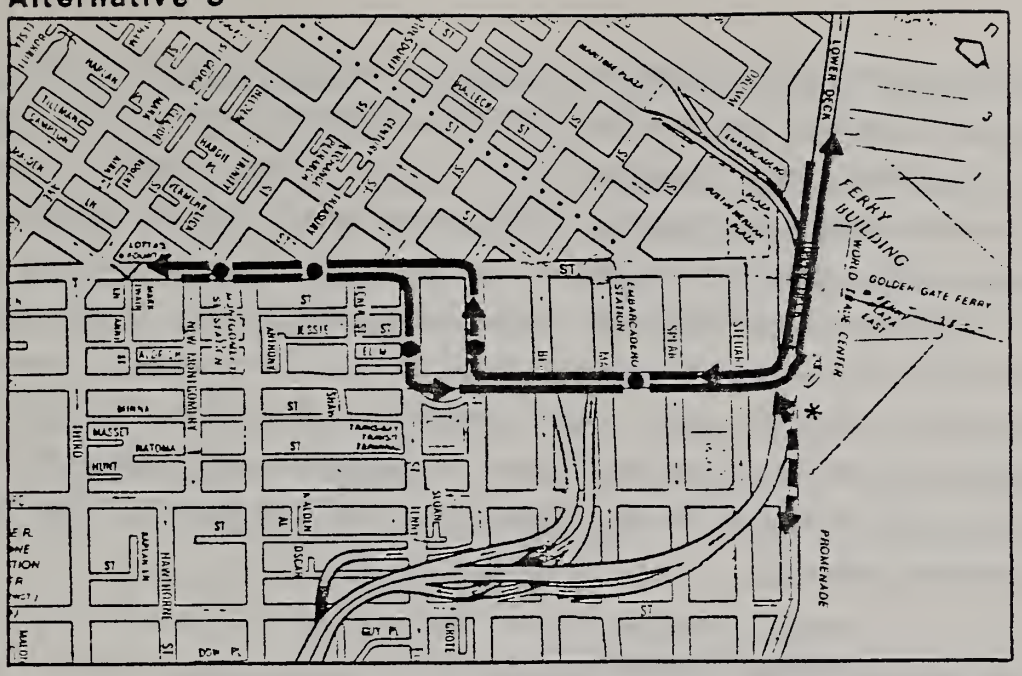
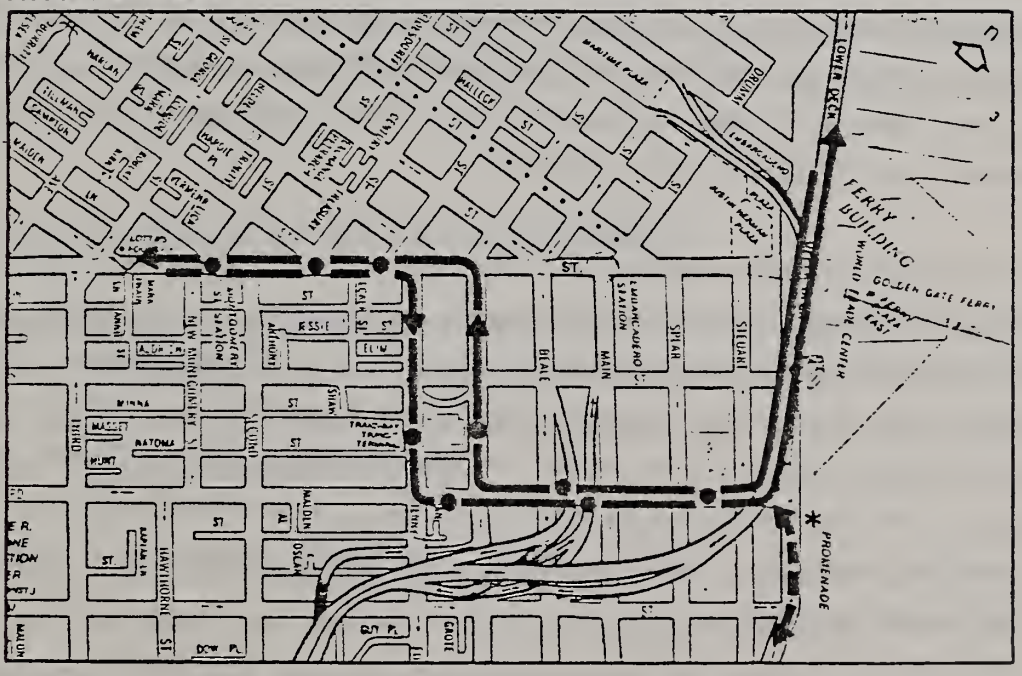
FIGURE VI-1
STREETCAR ROUTE EXTENSION ALTERNATIVES - EAST OF SECOND

Alternative 3



Alternative 4



● Passenger Stop
✱ Storage Maintenance Access

● **DKS Associates**
○ CHNMB
○ Ripley Bogatay
○ Foster Engineering
○ Jefferson Associates

Market Street Design/ Planning Study

Transportation Policy Group of San Francisco

FIGURE VI-2
STREETCAR ROUTE EXTENSION ALTERNATIVES - EAST OF SECOND

Layovers at the eastern terminus present problems. To provide layover capability west of the Embarcadero within the downtown sections of Market Street 1) would produce excessive traffic delays and congestion and (2) inconvenience streetcar passengers attempting to reach destinations easterly of the layover point. Due to the limited space available for on street storage or double track sections, it is not recommended layovers be provided along the revenue trackage. A few options are possible. First, should the E-line be extended northward to Fisherman's Wharf and a layover capability developed at this terminus, then with an easterly streetcar extension to the E-line, this layover space could accommodate both the E and the F-lines. Secondly, parallel to portions of the E-line extension, south of Market Street, a track siding could be built to accommodate a layover of streetcar vehicles.

Alternative 1 - Embarcadero via Market Street

This alternative requires approximately 4,400 feet of track. The option is a continuation of the existing trackage easterly to the Embarcadero. To maintain the existing 50 foot curb-to-curb width, new tracks would weave to allow for island stops. Passenger loading would be accommodated along Market Street at First, Beale and either at Steuart or within the Justin Herman Plaza. The westerly end of the track would be integrated into the trackage between Fremont and First Streets.

The only turning movements required for this option are to and from Market at the Embarcadero. To facilitate these movements, a streetcar signal phase would be required. This would disrupt existing traffic flows along the Embarcadero. Integration of the existing pedestrian traffic signal in front of the Ferry Building with the streetcar signal would minimize the negative impact on Embarcadero traffic. During AM peak-hour operation extensive levels of auto traffic northbound from Main Street enter Market Street proceeding west and exit onto Pine. This traffic would be in conflict with eastbound streetcar operations.

To ensure operational feasibility on Market Street east of Fremont Street the capability of extending streetcar tracks down Market Street over the BART Embarcadero Station was assessed (see Technical Appendix). It was concluded that streetcar tracks could be

extended to the Embarcadero. Preliminary costs for the rail extension over the Embarcadero station is $2,200,000 in 1982 dollars. Within the Justin Herman Plaza, pavement modifications would be needed to accommodate the new trackage. Further, a detailed alignment analysis would be needed to determine the best means to integrate streetcar operation into the proposed E-line trackage. Preliminary analysis suggests that Alternative I could be easily integrated into any finalized E-line alignment.

Track placement of Alternative I affects street conditions east of Fremont Street towards the Embarcadero. Between Fremont and the Justin Herman Plaza, Market Street has been developed to its final configuration. Reconstruction would be needed where trackage crosses pedestrian crosswalks or where tracks cross the center-street granite strips (weaving of tracks needed to allow retention of the 50 foot curb-to-curb width and to accommodate loading islands). In addition, reconstruction would be needed over the Embarcadero BART Station where structural support and reinforcing elements are necesary to place track over vent structures. It should be noted that portions of Market Street from the Justin Herman Plaza to Spear are planned to be torn down as part of the MUNI Metro extension project. Additionally, should the I-280 transfer project require reconstruction along the Embarcadero, portions of the Justin Herman Plaza may need modifications.

Alternative 2 - Embarcadero via Drumm and Washington

This extension, which provides less direct access to the Justin Herman Plaza area, does not require major reconstruction at the foot of Market Street east of Main Street and within the Justin Herman Plaza. To accommodate this connection, approximately 5,500 feet of trackage would be required.

This alternative requires three turning movements. One at Drumm and Market, one at Drumm and Washington and the last into the Embarcadero from Washington Street. Track alignment on Market would be provided by weaving track east of Fremont. Along Drumm and Washington Streets, the tracks would be located adjacent to the existing center medians.

Two major intersections are effected by this option. The first is at Drumm and Market Streets. Currently, Main Street is one-way northbound providing major AM access to the downtown via Drumm and California and Sacramento Streets. In the evenings, some southbound traffic on Drumm Street from California and Clay streets turns left into Market and proceeds east to Spear were it turns and proceeds south. To accommodate streetcar operations the following improvements would be needed. The westbound stop bar on Market Street should be pulled back (eastward) about 40 feet to allow room for the left turn streetcar maneuver into northbound Drumm Street. The most important traffic movement at Market and Drumm is the northbound Main Street to Drumm Street traffic flow. To allow adequate time for the streetcar maneuver, it is recommended that the westbound Market Street traffic signal green time be reduced. To gain additional signal timing, the southbound left turn from Drumm Street into eastbound Market should be eliminated.

The second intersection where delays could be created due to streetcar operation is at Sacramento and Drumm Streets. During the AM peak period, there is a significant left turn movement into Sacramento from Drumm Street. Streetcars operating in the center lane would be delayed by these left turning vehicles. This delay could be minimized by providing a streetcar actuated leading left turn phase on northbound Drumm Street.

The I-280 Transfer Study evaluates the impacts of eliminating or modifying the Embarcdero Freeway. Among the alternative configurations is the elimination of the Clay and Washington off-ramps. Should this condition occur, traffic destined for those arterials would use at-grade facilities and therefore would cross the proposed path for the streetcar extension. These conflicts would significantly reduce the effective travel time for the streetcar operation.

In addition to stops along Market Street, passenger loading platforms would be located between the Embarcadero Plaza Towers. To accommodate the loading zone curb parking adjacent to the island would be eliminated.

The next two alternatives (3 and 4) propose access to the Embarcadero via Mission and Howard Streets. Particular attention should be given to the relationship of these concepts to overall areawide traffic patterns.

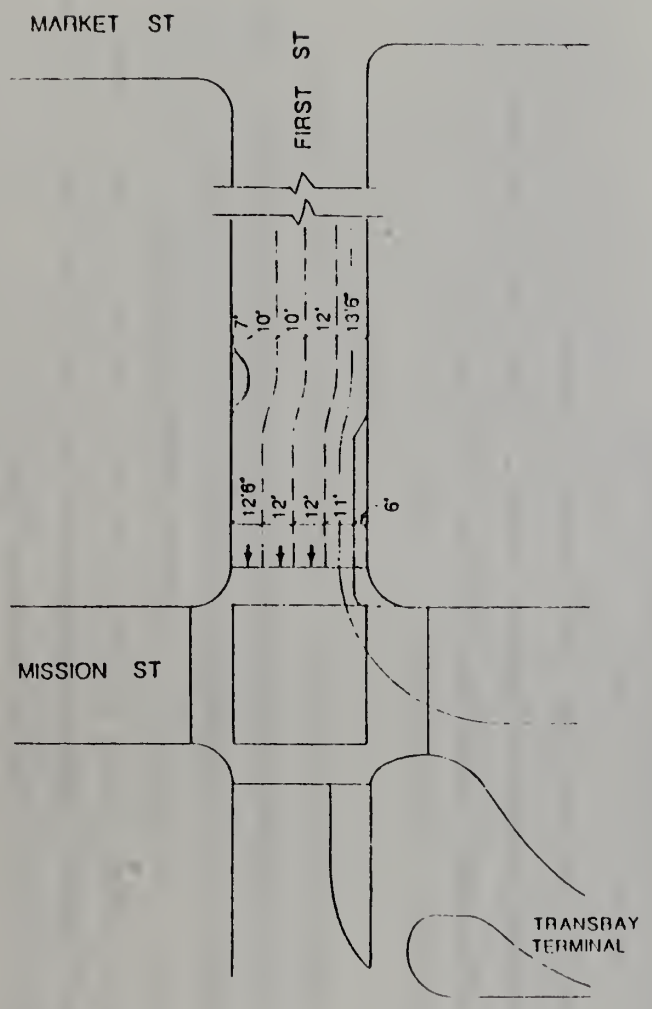
During PM peak-hour, portions of Beale, Fremont, First, Mission and Howard Streets experience extensive congestion. Further, pedestrian and transit vehicle operations adjacent to Transbay Terminal further aggravate traffic congestion. During the PM commute periods ramps and surface streets serving the Bay Bridge provide needed vehicle storage capacity. This condition results in congestion along major freeway access corridors like Beale and First Streets, near the Transbay Terminal. Therefore, Mission Street from Ecker to Main Street is highly congested during PM peak periods.

Another aspect of the south of Market Street congestion concerns northbound traffic movements along Fremont and Main Streets. Many San Francisco workers park under the freeway between Howard and Folsom Streets. In the evening, some of these commuters proceed north to reach California and/or Sacramento Streets. In the proximity of Mission Street these travelers encounter delays caused by the southbound travellers discussed above. Consequently, northbound Fremont, south of Mission, is congested as well as the linkage on Howard between First and Fremont streets. These traffic conditions would effect Alternative 3 and 4 by restricting the travel time for streetcars to reach both Mission and Howard Streets. Further, traffic delays south of Market on the Bay Bridge access routes would be impacted by streetcar operations.

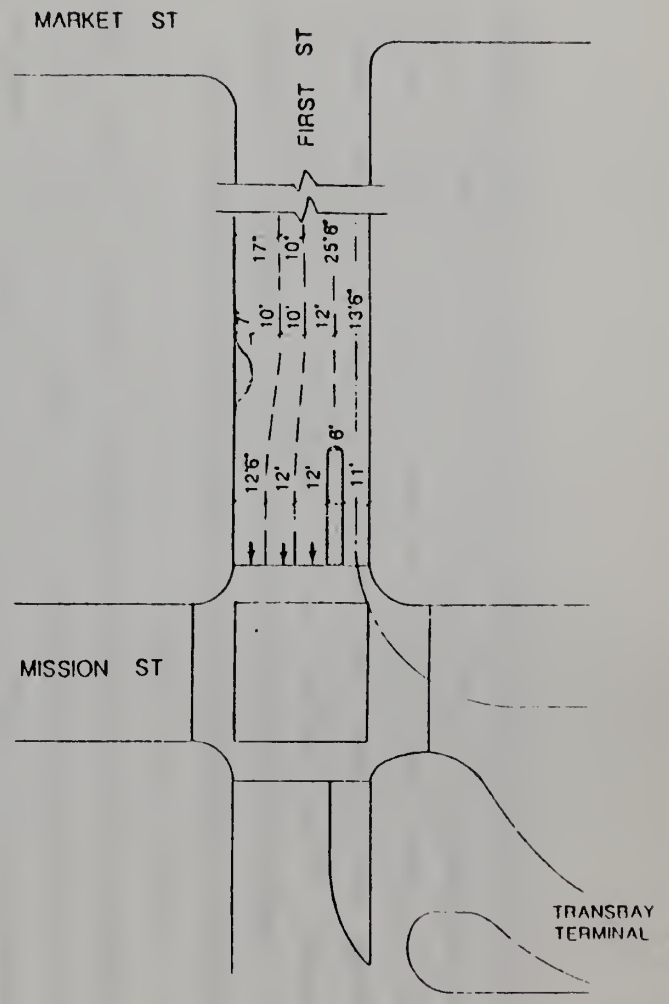
Alternative 3 - Mission/Embarcadero via First and Fremont

This alternative requires approximately 5,600 feet of track and splits the directional flows of streetcar operation onto two separate streets - First Street (southbound) and Fremont Street (northbound). Along Mission Street, streetcars would operate in the center of the street.

Passenger loading along Fremont and First Streets would occur between Mission and Market. A stop on First Street would occupy the left curb lane near Mission Street. Similarly, along Fremont, a stop would be placed far side of Mission in the left northbound travel lane. Two options for passenger loading are feasible. First, if the streetcars can load on either side, a left hand curb stop could be provided. Secondly, with right-side-only transit loading, islands would be needed at both locations. Schematic drawings for these options are shown on Figure VI-3.



OPTION 1: FIRST STREET ISLAND STOP
ALTERNATIVE 3



OPTION 2: FIRST STREET CURB STOP
ALTERNATIVE 3

● **DKS Associates** ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE VI - 3 **FIRST STREET TRANSIT STOP ALTERNATIVES**

Mission Street is only 52 feet wide, therefore, no island stops can be provided without restricting the existing traffic lane configuration and curb parking. Further, traffic congestion during peak-periods is excessive. Besides major congestion between First and Fremont in front of the Transbay Terminal, the intersections of Mission and Beale and Mission and Main are congested. Major traffic flows from north of Market access I-80 at Beale thereby restricting traffic in both directions on Mission. Due to these constraints, it is most probable that the first passenger loading stop on Mission would be located east of Main Street.

Generally, traffic congestion on Mission between First and Main is worse than on Howard Street between these blocks.

The use of Mission Street for streetcar operation would require a special signal phase for the right turn into Fremont from westbound Mission. Further, special signal phasing would be required to access the Embarcadero.

Mission Street is extensively congested during peak periods. The major contributors to this congestion are 1) traffic flows along First Street between Market and Harrison trying to access the Bay Bridge 2) transit access to and from the Transbay Terminal, 3) northbound movements onto the freeway at Beale and 4) major pedestrian activity levels on Mission between Beale and First Streets. To compound this existing condition with streetcar operations on Mission Street would be detrimental to maintaining good transit service. Furthermore, if the Embarcadero Freeway is torn down, traffic congestion and duration of the peak period on Mission could increase significantly.

Alternative 4 - Howard/Embarcadero via First and Fremont

This alternative requires approximately 6,700 feet of trackage. Passenger loading areas would be accommodated on each side of the Transbay Terminal at street level. Eastbound, passenger loading would occur on Howard at two locations: 1) near side of Howard at Fremont; and 2) nearside of Howard at Main Street. Westbound stops would be provided on Second near Mission. Westbound stops would be provided at two primary locations: 1) nearside of Howard at Spear (Rincon Point); and 2) on Fremont (northbound)

at the street level entrance to the Transbay Terminal. To accommodate the Howard Street stops with the exception of nearside Howard at Fremont, the existing curb would be moved to the edge of the travel lane and curb parking would be eliminated.

There is a MUNI bus layover area between Beale and Main Streets on both sides of Howard Street under the freeway. For streetcar operation, tracks must be placed in the two travel lanes adjacent to the existing curb parking lane, otherwise the layover area must be relocated. To provide three westbound travel lanes along Howard, accommodate the right turn into northbound Fremont and provide space for track transitions across the Beale/Howard street intersection, curb parking between Fremont and Beale on both sides of Howard would be eliminated.

Signal phasing to accommodate streetcar turning maneuvers would be required at First and Market (right turn), First and Howard (left turn), Fremont and Howard (right turn) and Fremont and Market Street (left turn). Signalization to access the Embarcadero would also be required. The junction with the E-line tracks along the Embarcadero should include a southbound connection for access to a possible future storage yard and maintenance facility near the Southern Pacific depot. Signalization phasing to allow for the left turn from First Street into Howard would delay westbound Howard traffic flows. If MUNI Metro is extended to the existing Southern Pacific depot, there would be an at-grade crossing of the MUNI Metro and F-line tracks at Howard and Steuart Street.

During the PM peak period, First Street is often congested because freeway bound traffic from north of Market can not be accommodated. First Street becomes a storage facility for these vehicles which could cause excessive streetcar delays. If streetcars are operated on this segment, an "auto-free" lane should be provided. This concept was utilized when streetcars served the Transbay Terminal; however, the concept did not work successfully. The major problem was the City's desire to maintain left turns for autos into eastbound Mission. If this left turn were eliminated the "auto-free" streetcar lane would work effectively.

Table VI-1 summarizes selected criteria and impacts for each alternative. Cross lane turns are defined as streetcar movements which require a separate signal phase. For example, the right turn into First Street from the center traffic lane of Market Street. Eastbound through traffic on Market would be stopped during this phase. Traffic flow disruptions refer to locations where conflicts produced by streetcar operations would occur. Track lengths are approximate estimates, the amount noted is measured from the intersection of First and Market.

Evaluation of Alternatives

Of these alternatives, the Drumm Street (Alternative 2) and the Howard Street (Alternative 4) options seem most feasible. Each provides specific benefits depending on the service priority selected. For example, the Drumm Street option provides the shortest travel time linkage to Fisherman's Wharf with the lowest implementation cost. The Howard Street option would connect streetcar service to the Transbay Terminal, Rincon Point Redevelopment area and potential locations for the proposed Southern Pacific Depot relocation.[1] Additionally, a potential at-grade crossing with the MUNI Metro trackage would occur allowing direct transfer between systems and provision of a non-revenue service track connection.

STREETCAR ROUTE ALTERNATIVES: CIVIC CENTER

This section describes potential streetcar service extensions at the western end of Market Street near the Civic Center area.

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1 California Department of Transportation, "San Francisco Commuter Rail Station Relocation Study: Working Paper 2", June 1982.

Table VI-1
EAST MARKET STREETCAR ALTERNATIVES

Criteria	Alternatives 1	2	3	4
Trackage (feet)	4,400	5,500	5,600	6,700
Eastbound turns	1	3	3	3
• Cross lane	-	-	2	2
Westbound turns	1	3	3	3
• Cross lane	1	2	3	3
Separate signal phase needed	1	2	5	5
Traffic flow disruptions	1	3	5	6
(Define)	A	B,C,D	E,F,G	E,F,H I,J

A. Embarcadero/Market
B. Drumm/Market
C. Sacramento/Drumm
D. Drumm/Embarcadero
E. Fremont/Market
F. First/Market
G. Mission/Embarcadero
H. Howard/Embarcadero
I. Fremont/Howard
J. First/Howard

The Western Loop Concept

If streetcar operations are maintained along Market Street, it seems appropriate to modify the existing track alignments to serve additional destinations. The MUNI Metro system has been developed to provide the major elements of commuter and other transit access within the Market Street Corridor. Continuation of surface streetcar operation would be to primarily serve two other demand segments. First, should streetcars be operated along Market Street with an easterly connection to the Embarcadero, linkage with the proposed E-line service could be developed. This creates a very viable recreational linkage between Market Street and Fisherman's Wharf. Further, the expanded service would enhance shopper facilities along Market Street.

Second, the San Francisco Civic Center area is a significant visitor (tourist/sightseeing), social, and recreational destination. Consequently, the interlinking of Market Street streetcar service with the Fisherman's Wharf/Embarcadero area would greatly enhance the success of this service.

The following sections are devoted to describing alternative routing schemes which were analyzed for the Civic Center area. The advantages and disadvantages of each proposal are also included.

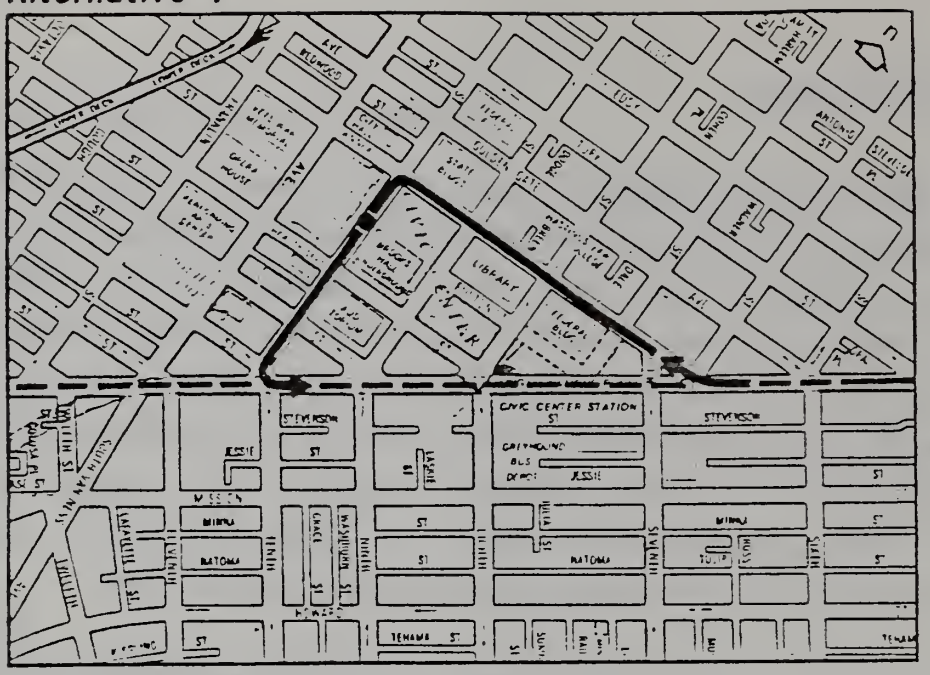
Civic Center Area - Streetcar Routing Alternatives

Eight alternatives were analyzed which allow variations to generate additional sub-alternatives. None of the schemes analyzed can be operated without effecting the existing traffic circulation system. Impacts and operational issues (layover points, terminals and turnarounds) are discussed below.

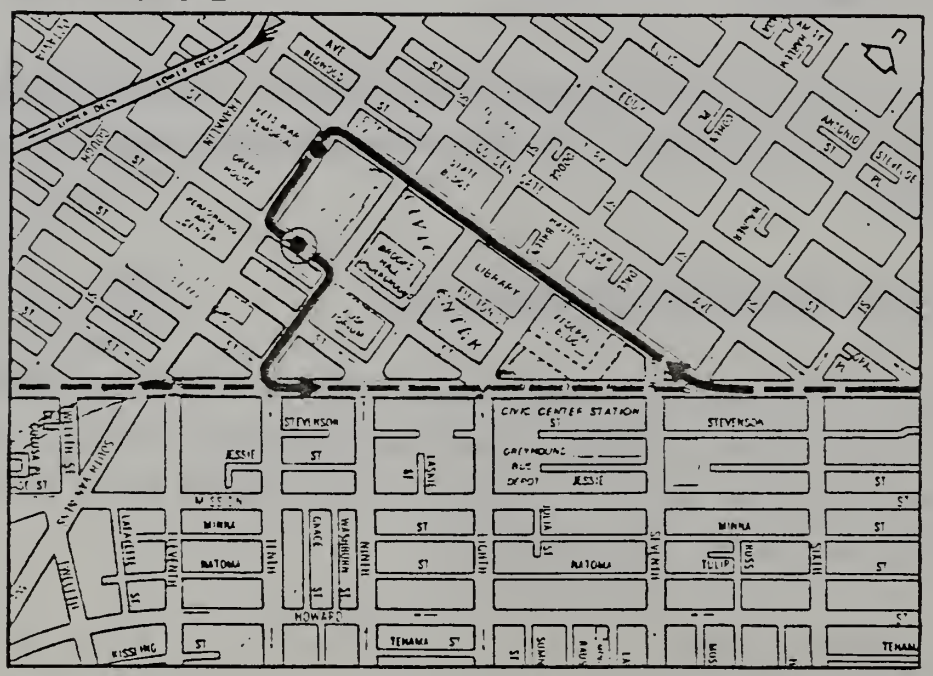
Alternative 1 - McAllister/Polk

This route requires approximately 3600 feet of new track (Figure VI-4). The loop would operate counterclockwise with three turn movements: one into McAllister from Market; a second from McAllister into Polk and a third from Polk into Market at 10th Street.

Alternative 1



Alternative 2



New Trackage
Existing Trackage
Loading Zone
Potential Layover Point

DKS Associates CHNMB Ripley Bogatay Foster Engineering Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE VI-4 **STREETCAR ROUTE EXPANSION ALTERNATIVES-CIVIC CENTER AREA**

Between Market and Polk, streetcars would operate down the center of McAllister. Along Polk Street center-street operation would continue except between Grove and Market were left side curb operation is suggested. This would require removal of curb parking for two city blocks.

Operationally, this alternative has two constraints. First, to accommodate the right hand turn into McAllister from Market, the westbound stop bar on Market at Jones would need to be moved easterly 120 feet with a separate signal phase for streetcars. This would delay outbound MUNI service in the curb lane. Additionally, delays would be experienced by autos entering Market via Jones Street. Secondly, Polk Street in front of the City Hall has an imbalanced traffic lane configuration. This would require a tight, but feasible, turn into Polk from McAllister.

A loading island and layover point would be established in front of the City Hall on Polk Street. Angle parking in front of City Hall must be converted to parallel parking to make room for the loading platform.

The existing traffic flows and lane configurations along the route can be maintained. Most required turns are left hand. The re-entry of streetcars from Polk into Market at 10th does not require a separate signal phase. This routing discharges passengers at the hub of the Civic Center area (City Hall) providing very easy access to all recreational destinations.

A problem associated with any alternative serving the City Hall area is the numerous disruptions of service caused by street closures (Polk) when special public events occur at City Hall. This condition effects Alternatives 1, 4, 5, 6 and 7. For these periods, service would operate along Market Street to Van Ness Avenue only.

Alternative 2 - McAllister/Van Ness/Grove/Polk

This variation to Alternative 1 loops behind City Hall on Van Ness rather than operating on Polk Street (Figure VI-4). This configuration is 1,000 feet longer than Alternative 1 and requires two additional turns. Loading islands would be located on Van Ness at

McAllister (adjacent to Veterans War Memorial) and on Grove adjacent to City Hall, near Polk. Layover would occur at the Grove Street stop.

The operation of streetcars along Van Ness Avenue presents a number of problems. The streetcars could operate within the center planter area with pedestrian access via the existing south crosswalk at McAllister. Heavy traffic on Van Ness could make this movement potentially unsafe. To provide adequate space for the streetcar tracks, platform and to allow the simultaneous left turn of streetcar and autos, it would be necessary to convert the existing northbound center lane into a widened median for streetcars. To maintain the required three northbound traffic lanes on Van Ness Avenue, either northbound curb parking between McAllister and Grove could be eliminated or the street could be widened on this section by moving the easterly curb 12 feet. Provision of a center streetcar track on Polk would require conversion from angle to parallel parking adjacent to City Hall and a shifting of the westbound lanes 12 feet to the north.

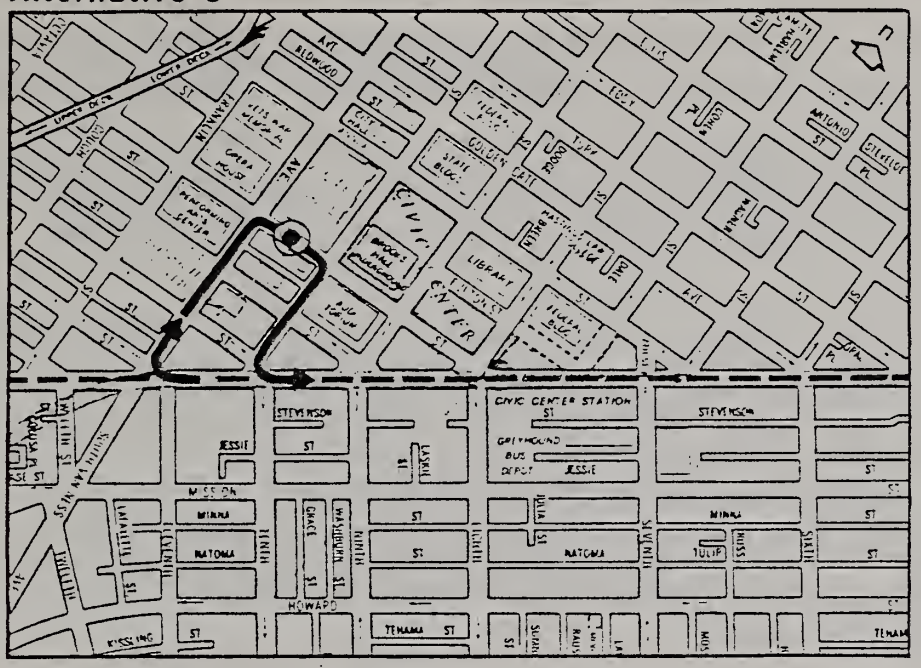
This option requires the same signalization at McAllister/Jones and Market as Alternative 1. At Polk and Grove a separate signal phase would be required for the streetcar left turn, which would delay southbound traffic movements along Grove Street towards Larkin.

Alternative 3 - Van Ness/Grove/Polk

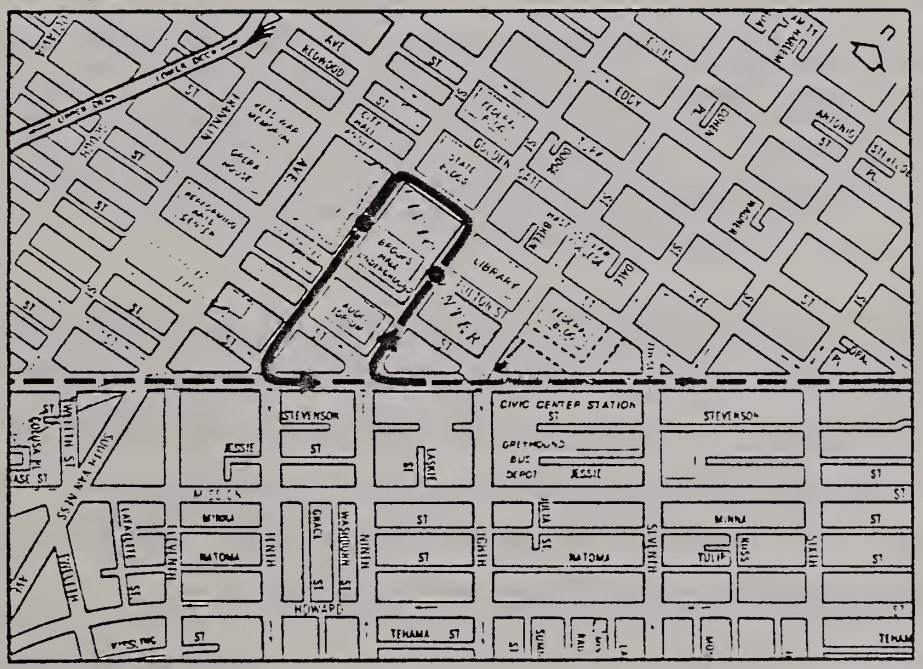
This route requires the least amount of new trackage, approximately 2500 feet (Figure VI-5). However, the loop would operate clockwise and requires a tight 125 degree turn at Van Ness and Market. A transit stop and layover would be located on Grove between Polk and Van Ness.

Streetcar operation within the existing median of Van Ness could not be accommodated due to conflicts with opposing southbound left turn lanes on Van Ness. Also, median streetcar operation would require stopping northbound Van Ness traffic at Grove Street to allow the streetcars to turn right onto Grove Street. For these reasons, it would be advantageous to operate streetcars in the curb northbound traffic lane between Market and Hayes. At transit stops the sidewalk would be extended into the parking lane for

Alternative 3



Alternative 4



New Trackage
Existing Trackage
Loading Zone
Potential Layover Point

DKS Associates CHNMB Ripley Bogatay Foster Engineering Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE VI-5 **STREETCAR ROUTE EXPANSION ALTERNATIVES - CIVIC CENTER AREA**

boarding. Between Hayes and Grove the track would be located in the raised median. The existing left turn lane to Grove would be eliminated. A separate traffic phase would be needed to allow the right turn from Market into Van Ness and into Grove from Van Ness Avenue. This added delay would contribute to added auto congestion and delay MUNI rubber tired vehicles on westbound Market and northbound Van Ness.

Tight turning radii, similar to the one needed at Van Ness and Market exist throughout San Francisco; however, they typically cause traffic delays due to slow turning speeds. At Van Ness and Market less green time would be available for auto and bus movements. Moreover, all westbound Market Street and northbound Van Ness Avenue traffic would need to be stopped to allow the streetcars to safely navigate the turn. The right turn signalizaton requirements at Grove and Polk noted for Alternative 2 would also occur under this alternative.

Alternative 4 - Larkin/McAllister/Polk

This alignment adds 3,000 feet of track and requires four turns (Figure VI-5). A tight right turn into Larkin Street similar to the one at Van Ness and Market is required. This alternative loops around Brooks Hall in a counterclockwise direction. Passenger loading could be accommodated on Larkin at Fulton and on Polk in front of the City Hall. A layover point could be allowed in front of City Hall. Each stop will require elimination of curb parking to create space for platform.

The stop bar for westbound Market Street traffic at Market and Ninth must be moved easterly approximately 120 feet to allow streetcars access into Larkin Street. Northbound and westbound traffic would be delayed to allow the streetcars to safely enter Larkin on a special signal phase and conclude this turn into the left hand travel lane on Larkin. This configuration would allow smooth transition into the center northbound travel lane along Larkin Street north of Larkin.

As with Alternative 1, streetcar operation along Polk between McAllister and Grove would be in the center southbound travel lane. South of Grove, the streetcar would occupy the left travel lane.

Alternative 5 - Larkin/Grove/Polk/McAllister/Hyde

Approximately, 3300 feet of track is needed to accommodate this clockwise loop (Figure VI-6). Streetcars would leave Market at Larkin, operate to Grove, Polk and McAllister then return to Market either via Hyde Street or Fulton (United Nation's Plaza). This alternative requires six turning movements. Further, to operate along Polk in front of City Hall, one southbound lane would be eliminated. Along McAllister, between Polk and Larkin center street operation requires joint use of the single southbound traffic lane or the elimination of the curb parking area. The movement into Market Street from Hyde is a reversal of the 125 degree turn from Van Ness into Market (Alternative 3). Since Hyde is one-way south of McAllister and curb operation would be required to reduce traffic delays at Market Street, the use of Fulton Street through United Nations Plaza should be considered.

Passengers loadings would be provided in front of City Hall and within United Nation's plaza. The designated layover would be the City Hall stop.

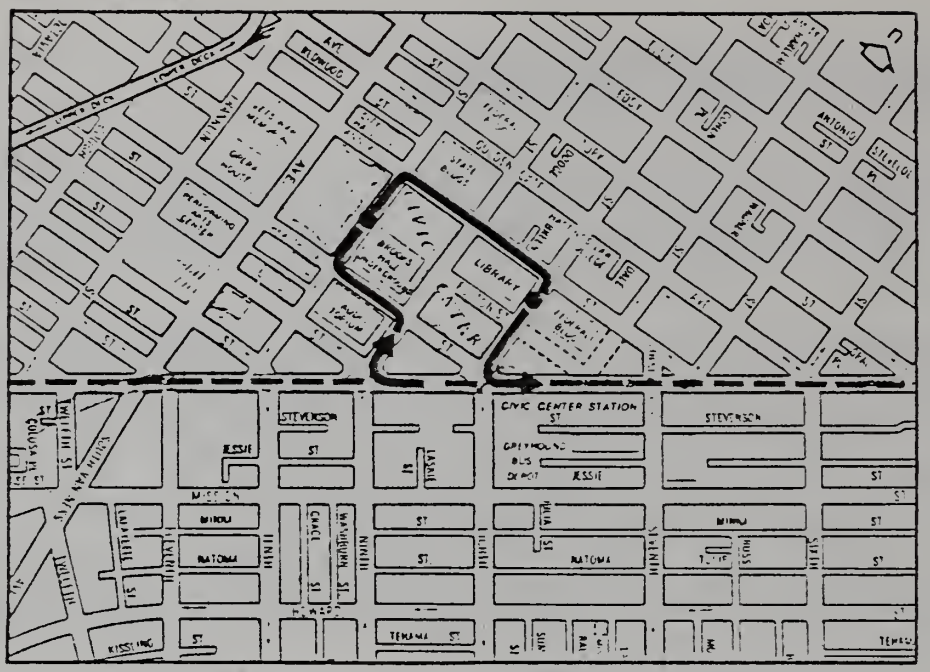
The traffic signalization issues noted for Alternative 4 at Larkin/Hayes and Market are also encountered for this alternative. At Grove and Polk, signal phasing must be changed to delay northbound traffic on Grove when streetcars turn right into Polk. This same turning movement signalization problem exists at Polk and McAllister.

Generally, when right turns are required for streetcar operation, except when the streetcars operate within the right travel lane, all other approaching traffic must be stopped to accommodate this turning movement.

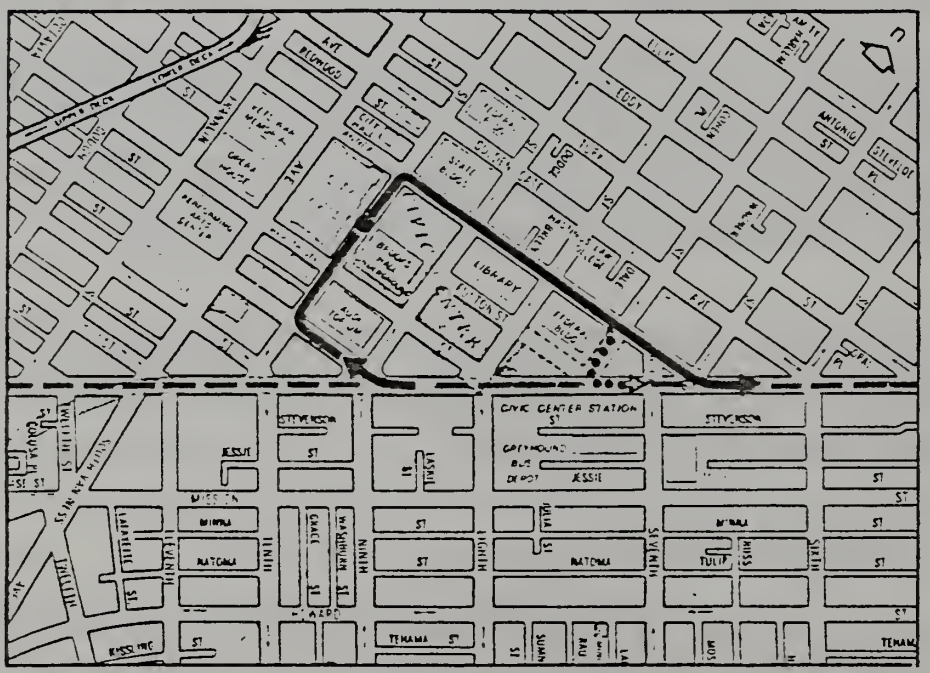
Alternative 6 - Hayes/Polk/McAllister

This loop requires 3,500 feet of trackage and operates in a clockwise configuration (Figure VI-6). It requires a contra-flow lane between Hayes and Grove on Polk and along McAllister between Hyde and Market Street. To be feasible the one-way segment of Polk Street between Hayes and Grove would be reversed or a southside contra-flow lane would be needed. Signalization of 9th and Market would need modification to allow

Alternative 5



Alternative 6



New Trackage
Existing Trackage
Loading Zone

● **DKS Associates** ○ CHNMB ○ Ripley Bogatay ○ Foster Engineering ○ Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE VI-6 **STREETCAR ROUTE EXPANSION ALTERNATIVES-CIVIC CENTER AREA**

access into Hayes. Truck loading for shows at Brooks Hall could result in a blockage of the tracks. At 7th and McAllister and at Market and McAllister signalization would be required to allow adequate time for streetcar movements within these intersection.

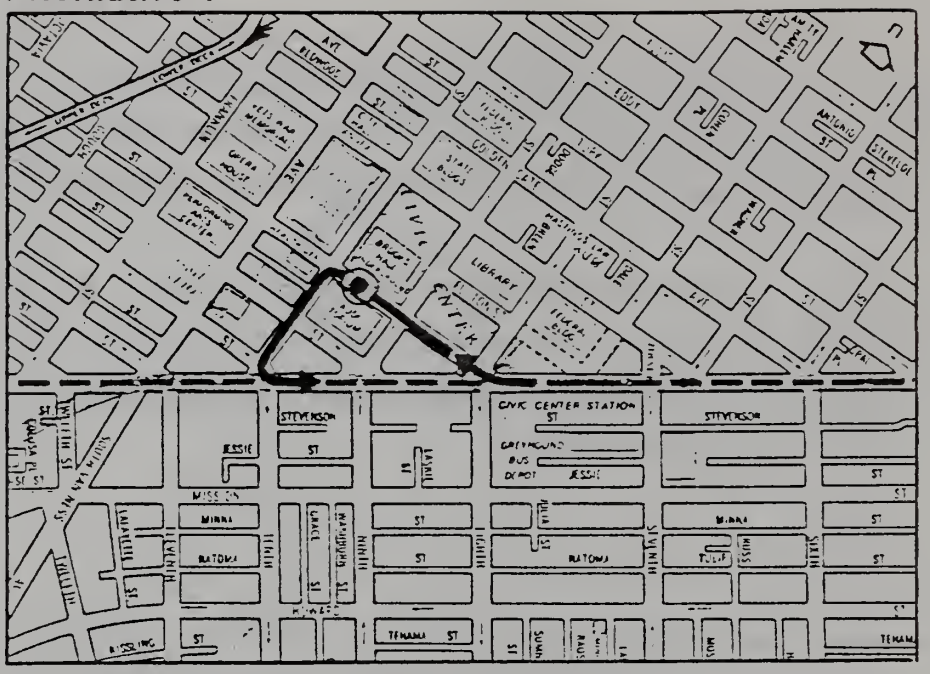
Passenger loading and layovers would occur on Polk at City Hall. Access to Market Street would require an extra phase and would involve crossing of the westbound track. A better alternative may be via United Nations Plaza at Leavenworth. A transit stop could easily be included in the plaza area.

Alternative 7 - Grove/Polk

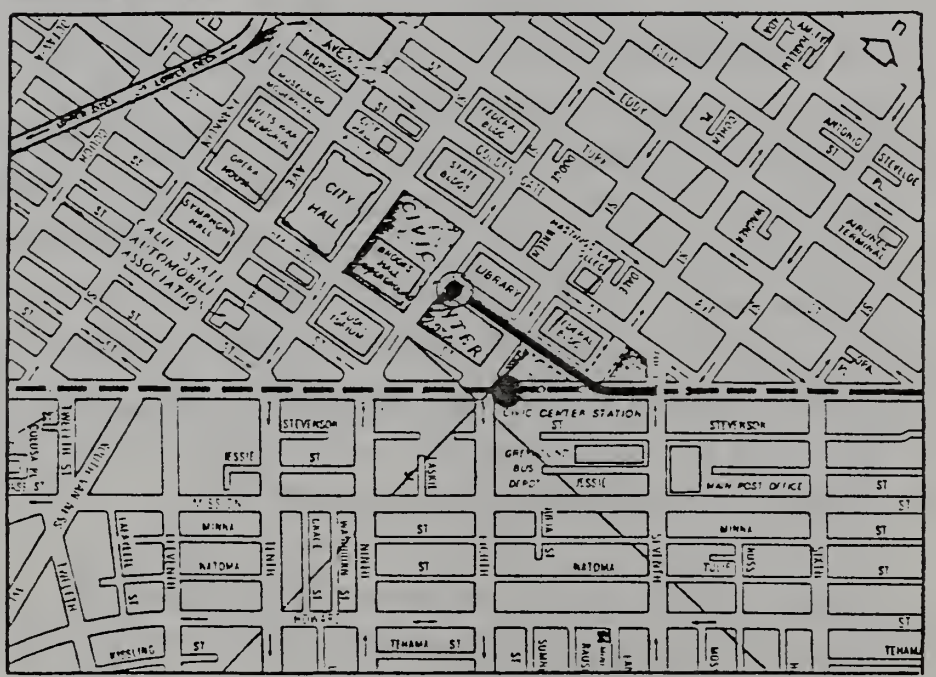
This loop requires approximately 2,000 feet of track and requires three turns (Figure VI-7). The loop would operate counterclockwise leaving Market at 8th Street and re-entering Market at 10th via Polk. To accommodate the right turn into Grove, the westbound stop bar on Market would be moved easterly about 20 feet. Also, southbound Hyde Street traffic would need to be stopped north of Grove to allow the streetcars time to enter Grove. It may be difficult to get traffic to stop this far back from Market Street. Any violation would result in blockage of the track. The "S" curve needed to navigate this turn may require widening the southern end of Grove Street. Currently, the sidewalk on the southbound approach to Market on Grove widens to accommodate a BART entrance. Preliminary assessment indicates that this sidewalk section could be narrowed at least 5 feet which would allow adequate maneuvering room to accommodate the Market to Grove Street streetcar move. At Grove and Polk, the northbound stop bar should be pulled back to allow adequate room (radius) for the left turning streetcars to conclude their turn in the left hand travel lane on Polk. The reentry maneuvers onto Market at 10th Street would be accommodated as proposed for Alternatives 1, 2 and 3.

Passenger loading and a wide layover is proposed on Grove at Polk Street. Angle parking would need to be converted to parallel parking on the northside of Grove between Larkin and Polk to accommodate track and platform.

Alternative 7



Alternative 8



New Trackage
Existing Trackage
Loading Zone
Potential Layover Point

DKS Associates CHNMB Ripley Bogatay Foster Engineering Jefferson Associates	Market Street Design/ Planning Study Transportation Policy Group of San Francisco	FIGURE VI-7 **STREETCAR ROUTE EXPANSION ALTERNATIVES-CIVIC CENTER AREA**

Alternative 8 -- Fulton/United Nations Plaza

This option provides a stub (not a loop) terminal at Larkin and Fulton and requires approximately 1,200 feet of trackage (Figure VI-7). Access to Larkin Street would be via the United Nations Plaza. Reconstruction of the plaza (to provide a structural base) between Market and Hyde would be needed.

Passenger loading could be accommodated at the terminal (Larkin/Fulton) and within the United Nations Plaza. A portion of the on-street parking between Larkin and Hyde on Fulton would be eliminated as well as truck parking in the center of the street which occur before and after events at Brooks Hall. Layover of vehicles would be at the terminus of the stub.

This alternative has only two turn maneuvers, one into the plaza from Market Street and one exiting the plaza onto Market Street. To accommodate these moves, signal control would be required between Seventh and Eighth Streets. The existing UN Plaza pedestrian signal could be modified to allow streetcar turn movements.

As with the City Hall and Polk Street alternatives, portions of the United Nations Plaza are closed for special events and public assemblage. During these times, streetcar service would be either discontinued or rerouted to terminate at Van Ness and Market Street.

Evaluation Criteria

Table VI-2 summarizes the pertinant data for each alternative. None of the alternatives can operate without producing some disruption of traffic flows within the Civic Center area. Right turn maneuvers are not as advantageous for streetcar operation as left turns. Sight distances, especially when crossing through traffic lanes to accomplish a right turn from the center lane, are poor. Further, through traffic must be stopped while streetcars safely maneuver right turns. Therefore, a high level of right turns or cross lane turns should be discouraged.

Table VI-2
CIVIC CENTER STREETCAR LOOP ALTERNATIVES

Criteria	ALTERNATIVES 1	2	3	4	5	6	7	8
Trackage (Feet)	3,600	4,600	2,500	3,000	3,300	3,500	2,000	1,200
Total Turns	3	5	4	4	6-7	4	3	2
Rights	1	2	3	1	4	3	1	1
Lefts	2	3	1	3	2-3	1	2	1
Crosslane	1	3	3	1	4	4	1	1
Passenger Stops	1	2	1	2	2	1	1	2
Separate Signal Phases Needed	1	2	3	1	3	4	1	2
Traffic Flow Disruptions (Define):	2	3	2	2	3	2	1	2
	A	A,B,C	C,D,E	F,G	H,I,J	J,K,L,M	N	O,P

A Market/Jones
B VanNess Northbound
C Grove/Polk
D Van Ness/Market
E Van Ness/Grove
F McAllister W/B
G 9th/Hayes
H Polk Northbound
I McAllister Southbound
J 9th/Hayes
K Polk Northbound (Hayes-Grove)
L McAllister Southbound (Hayes-Market)
M Jones/Market
N 8th/Hyde/Market
O Fulton/Hyde
P Market/United Nations Plaza

Length of trackage and overhead wire requirement are the major cost elements, therefore the shortest trackage option should be the least expensive to build. Turns greater than 90 degrees, while feasible, reduce operational speeds significantly and increase intersection delay.

Each alternative presents a slightly different visual impact as streetcars reach the Civic Center area. Alternatives 1 and 2 establish City Hall as the first visible landmark and major terminus for passengers. Alternative 2 further enhances the visual impacts by providing direct exposure to the Opera House and Performing Arts Center.

Alternatives 3 and 4 approach the Civic Center area via Van Ness and therefore expose passengers to the Opera House/Performing Arts structures and terminate at the City Hall. Alternatives 5, 6, 7 and 8 are like Alternatives 1 and 2 because they are focused on Brooks Hall and City Hall, the only difference being how the streetcars arrive at or near City Hall.

Although each loop provides its own visual benefits and leaves passengers within easy walking distance to all major destinations, an informational display should be provided at the major terminal stop directing riders to the various tourist/sightseeing destinations in the area.

Each alternative delays or disrupts MUNI bus service along Market Street. Where streetcars turn off or reenter Market Street, through routes would be delayed until the streetcar maneuvers are completed. Along portions of McAllister, Larkin, Hyde, Grove, Polk, Hayes and Van Ness Avenue additional traffic delays would occur. Where right turn bus movements occur which do not cross streetcar turns less disruption to existing bus services will be experienced. For example, Alternatives 1 and 2 do not create a major disruption to the 5 McAllister service. Alternatives which operate along Van Ness (2 and 3) create delays for all bus/trolley operations along westbound Market Street and northbound Van Ness Avenue. In general, except where streetcars cross existing trolley and diesel bus routes, no major disruption occurs.

Evaluation of Alternatives

Of these alternatives, Alternative 8 (Fulton/United Nations (UN) Plaza) and Alternative 3 (Van Ness/Grove/Polk) are the most promising options to implement. The Fulton extension is the shortest and lowest cost option with a minimum of required turns and no additional passenger loading islands on Market Street.

Alternative 8 has stub turnaround between Hyde and Larkin allowing service turnaround without an elaborate loop and allows central penetration into the Civic Center area. In addition, a transit mall concept (similar to Powell between Ellis and Market) could be integrated with streetcar service between Market and Larkin. However, the UN Plaza is frequently used for public rallies which would interrupt streetcar service. Potentially, this area could be deemphasized for major public assemblage; however, it is more likely service would be discontinued at Market Street during special events (streetcars would use Eleventh Street wye for turnaround).

Alternative 3 provides the best streetcar access to Civic Center including service adjacent to the Performing Arts Center, Opera House, City Hall and government and state buildings within Civic Center.

MARKET STREET CAR MAINTENANCE OPPORTUNITIES

Currently the MUNI operates weekend streetcar service on Market Street with Presidents Conference Committee (PCC) cars. These streetcars are maintained and stored at the streetcar barn at Geneva and San Jose Avenues. The PCC cars currently access the Geneva Yard by entering the Twin Peaks Tunnel through a temporary portal at Castro Street and operate on the light rail vehicle (LRV) track south of Castro to the Geneva Yard. The streetcars must return to the yard each night for storage and for maintenance.

The current streetcar operation and maintenance program was adopted by MUNI as a temporary measure until the MUNI Metro was opened and streetcar service was discontinued. This has resulted in a make shift maintenance program which should not be continued if streetcar operations on Market Street were to be permanently retained.

The adoption of a satisfactory maintenance program for a permanent streetcar fleet requires that the following questions be addressed.

1. Where should the streetcars be stored overnight?

2. Where should light and heavy maintenance be performed? and

3. How should the streetcars get from Market street to the yard or yards where they would be stored and/or maintained?

Each of these issues and two feasible options for maintaining the streetcar fleet are presented below.

Streetcar Storage Issues

Assuming that a 30 vehicle streetcar fleet would be retained by MUNI then approximately a 15,000 square foot area or 1,500 lineal feet of track would be required to store the streetcars overnight.

The existing streetcar fleet is currently stored in the streetcar barns at the Geneva Yard; however, the barns are scheduled to be replaced by an LRV body shop and storage facilities for 56 light rail vehicles. The existing LRV facility does not have sufficient space for storing streetcars and LRV's.

One candidate storage location at the Geneva Yard complex would be the old temporary LRV storage tracks located across San Jose Avenue from the existing streetcar barns. This site is currently used to store PCC cars and is currently planned for a MUNI employee parking lot. There would be sufficient space and tracks at this site to just (barely) fit all 30 streetcars.

There is also a vacant parcel owned by MUNI (between Delano Street and the streetcar barns) which could potentially be used for streetcar storage. The current rehabilitation plans for the streetcar barns would probably have to be reworked to take maximum

advantage of the additional space on this site. However, this site is also coveted by local residents for a neighborhood facility.

Finally, streetcar storage at the Geneva Yard would require a nine mile round trip deadhead run each day by the streetcars to access Market Street.

Maintenance Issues

The PCC streetcars are among the most reliable of MUNI's equipment; averaging 850 to 1,200 vehicles miles per defect. In 1979 MUNI operated 90 PCC cars which logged a total of 3.6 million vehicle miles a day with 200 to 300 breakdowns (road calls) a month.

Streetcar maintenance can be divided into two categories: 1) light (preventive) and; 2) heavy maintenance. Preventive maintenance includes brake checks, routine adjustments, safety inspections, plus scheduled parts replacements. Light maintenance can often be performed in the same yard where the cars are stored if extra space for this function is provided. A combined storage and light maintenance yard for a 30 car fleet would require roughly 40,000 square feet of space with tracks spaced about 20 feet apart (centerline to centerline). Two to three service pits (holding up to 8 cars) would be required as well as washing facilities and a small shop. Twenty to twenty five persons might be employed at such a facility.

Heavy maintenance for a 30 car fleet would require an additional (four car capacity, double ended) pit plus much more extensive support facilities. One possible option would be to perform heavy streetcar maintenance in the current LRV shops. This would require some schedule and priority juggling to ensure that LRV maintenance were not adversely affected by the increased work load. It should be pointed out that this mixed-mode maintenance option is contrary to current MUNI facilities policy for the LRV yard.

There does not appear to be sufficient space at the existing and planned LRV maintenance complex for a new streetcar light maintenance and storage facility. If current rehabilitiation plans were modified sufficient space might be found to accommodate the streetcar fleet at the Geneva Yard.

Geneva Yard Access Issues

Assuming adequate space and facilities can be developed for streetcars at the Geneva Yard the next issue is how to develop a permanent (workable) access to the yard. The existing PCC streetcars (stored at Geneva Yard) currently use the Twin Peaks Tunnel to get to Market Street. This causes two problems, one of access to the tunnel at Castro Street and the other of joint LRV and streetcar operation within the tunnel.

The surface streetcars on Market Street currently access the Twin Peaks Tunnel at Castro Street via a temporary portal constructed of untreated wood. It is estimated (by MUNI) this portal will last less than 5 years. This temporary structure, built about 11 years ago (with a three year design to life), would have to be replaced with a permanent concrete structure if this access were to be retained.

The Twin Peaks Tunnel is currently set up for automatic train control with in-cab signals for the operators. The existing PCC streetcars do not have this equipment. Therefore, special provisions must be made to ensure adequate signal controls for safe operation.

The streetcars and LRV's currently have separate power pickups (poles vs. pantographs) which require a special wiring arrangement within the Twin Peaks tunnel. This joint wiring in the tunnel appears to be causing excessive pantograph wear (according to MUNI maintenance staff) on the LRV pantographs. Joint LRV and PCC car surface operation requires extra hardware for the dual power pick-up systems but otherwise causes few operational problems.

The above tunnel operation problems could be solved by outfitting the streetcars with pantographs and in-cab signals. However, pantographs may detract from the historical nature of the streetcar vehicle. Also, pantograph operation would not be possible on lower Market Street with the planned four-wire overhead trolley system and comingling power pickup for streetcar operation. The proposed overhead wire rehabiliation plan is only suitable for trolley pole operation.

Questions for Further Study

There are several unresolved issues in the above discussion which merit further investigation:

1. Investigate physical, financial and political feasiblity of modifying current MUNI Plans and reallocating space at the Geneva Yard for streetcar storage and maintenance.

2. The capital and operating cost of alternative downtown sites for a light maintenance and storage yard should be estimated.

3. The cost of rehabilitating the Castro Street Portals need to be determined.

Future Streetcar Maintenance Options

The various options for future streetcar maintenance boil down to the question of where the streetcars are stored and maintained. If the Geneva Yard complex is selected then various access alternatives can be considered (Castro, Portal, "J" Church Extension). If a downtown storage and light maintenance location is selected then the question becomes one of exploring site alternatives for the yard. The pros and cons of each option are briefly discussed below.

Option 1: Streetcar Storage and Maintenance at Geneva Yard. Current MUNI plans for the LRV yard at Geneva would make it physically impossible for streetcars to be stored and maintained at the Geneva Yard. However, juggling of the current plans may yield enough space for a permanent streetcar facility. Two proposed improvements that might be dropped in order to make room for the streetcars are the employee parking lot and the proposed neighborhood center.

Deadheading to the Geneva Yard would be a significant operational cost for the streetcars. The daily nine mile round-trip between Market Street and the Geneva Yard would cost an extra $330,000* a year.

Access to the Geneva Yard if via the Twin Peaks Tunnel would require as a minimum the upgrading of the temporary Castro Street Portal. In additon, installaton of in-cab signals would be desirable.

If and when the "J-Church" LRV line is extended to Balboa Park then the streetcars could use this surface track to access the Geneva Yard. The Twin Peaks Tunnel could be avoided entirely. The existing tracks connecting the surface of Market Street to the "J-Church" line at Church and Duboce Streets would have to be upgraded to permanent status eventually.

If and when the Market Street subway LRV lines are extended from Embarcadero Center to the surface at Steuart Street (connecting with the future E-Line and/or MUNI Metro Extension to the Southern Pacific Station) then the surface streetcars could use this connection and the Market Street subway to reach the Twin Peaks tunnel thus avoiding the temporary Castro Street Portal. Joint operations of streetcars and light rail vehicles for the full length of the subway would have to be worked out.

The "J-Church" extension, and Market Street subway extension options depend upon the implementation of currently unfunded long range MUNI expansion plans. If these plans are dropped then the only access option for the streetcars would be the Castro Street Portal.

Option 2: Develop Downtown Light Maintenance and Storage Yard for Streetcars. A light maintenance/storage yard near Market Street would significantly reduce the deadhead time that would be required under option 1.

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* Based on estimated annual opeating cost of $4.00/vehicle-mile x 9 mile round trip/day x 25 cars x 365 days/year (assume remaining 5 cars are kept in Geneva Yard as spares).

Possible downtown sites include a lot owned by the P.U.C Water Department on Bryant near Fourth Street and any midday LRV storage facility developed in conjunction with the proposed E-Line.

The Fourth and Bryant site is currently used by MUNI to store rail. Approximately 6,000 feet of new track on Third and Fourth Streets would have to be laid to reach this site. One advantage of this would be that it could be revenue track serving the Moscone Center, and peripheral parking near the James Lick Skyway.

Five year plan[1] proposals for the E-Line have included potential development of sites near the Southern Pacific Depot (Forth and King) for midday LRV storage. Any decision concerning provision of a storage or yard facility near Forth and King is pending evaluation of the I-280 Transfer Concept Program Study, by others. Should a storage or yard site be developed, the facility could be jointly used by the E and F-Line vehicles.

The light maintenance/storage yard would require about 40,000 square feet of land. Facilities would include service pits for eight cars, working area, fare collection equipment, and a small shop for parts, tools, and employees. Four tracks roughly 500 feet long each on 20 foot centers could accommodate both the storage and light maintenance functions at the yard.

Conclusions and Recommendations

While the issues of the precise costs of the two options and the feasibility of modifying current MUNI plans for the Geneva Yard have not been resolved, some tentative recommendations can be made at this time.

In the interim, until such time when the "J" Church extension is completed, streetcar tracks should be maintained on Market Street to the Twin Peaks Tunnel. Once the new

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1 San Francisco Municipal Railway, "Five-Year Plan: 1982-1987, Volume 3, Final Draft", April 7, 1982, page 3-8.

"J" Church service is initiated, streetcar maintenance access to the existing MUNI facilities at Geneva Yard would be accommodated via the "J" Church line. If the "J" Church line is extended within the next five years then the Portal need not be rebuilt. If the extension is delayed then the Portal reconstruction should be charged to Market Street Project.

For long term planning, a separate maintenance facility should be pursued south of Market. This facility should accommodate both heavy and light maintenance requirements of streetcars. Additionally, if space is available, storage or minor maintenance of LRV's could be accommodated. The I-280 Transfer Concept Program study will determine the ultimate status of the E-line, MUNI Metro extension and Southern Pacific depot relocation.

PATRONAGE PROJECTIONS

Streetcars operating along Market Street should generate ridership from four general markets. These include: northeast waterfront, commercial and administrative activity, tourism, shopping and localized (Market Street) circulation. In addition, depending on the east end route alternative selected, penetration into the Rincon Point Redevelopment area could provide additional ridership demand. A search of historical data to quantify the levels of ridership produced by these markets proved unsuccessful. However, an attempt was made to quantify the tourism and shopper markets adequately to provide a broad estimate of potential streetcar patronage. These assessments are detailed in the Technical Appendix.

It is estimated that of the total daily tourist market nearly 50 percent could use a surface historic streetcar.[1] This demand varies between 15,000 and 22,000 daily trips (December versus May and June). Assuming 14 hours of service, (7 AM - 9 PM) a 10 minute headway service would carry up to 130 riders per trip. To create this level of

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1 Developed by Jefferson Associates, see Technical Appendix for details.

ridership, the streetcar would need to be extended east of Fremont to serve the Embarcadero/Fisherman's Wharf area.

In addition to serving recreational and tourist trips, the streetcars would provide added transit capacity along Market Street for local shopping and other travel. With streetcar linkages to the Civic Center area, potential for expanded streetcar ridership is generated.

The operations of historic streetcars along Market would allow users to access the Fisherman's Wharf area via Market Street with proposals[1] for Embarcadero transit service. This would provide an alternative to the Cable Car operations at the foot of Powell Street. A "closed" loop would be created with streetcar and cable car routes between Market Street, the Embarcadero and Fisherman's Wharf. A portion of the existing Cable Car patronage could use the historic streetcar service which would partially relieve the presently overburdened system.

In total, it is estimated that between 22,000 and 40,000 riders per day could use the historic streetcar. This level of ridership would produce a maximum total trip volume of 130 to 240 riders.

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1 San Francisco Municipal Railway, "Five Year Plan, 1982-1987, Volume 3, Final Draft", April 7, 1982.

CHAPTER VII
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